| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 19 | BRS | 12 | (reflectometry and probe).clm,ab,ti. and high adj frequency | USPAT; US-PGPUB | 2002/02/21 17:58 | | | 0 |
| 20 | BRS | 0 | (reflectometry and probe).clm,ab,ti. and high adj frequency and traces | USPAT; US-PGPUB | 2002/02/06 13:14 | | | 0 |
| 21 | BRS | 0 | (reflectometry and probe).clm,ab,ti. and calibration and verification | USPAT; US-PGPUB | 2002/02/06 13:15 | | | 0 |
| 22 | BRS | 22 | (reflectometry and probe).clm,ab,ti. and calibration | USPAT; US-PGPUB | 2002/02/06 13:16 | | | 0 |
| 23 | BRS | 0 | (reflectometry and probe).clm,ab,ti. and calibration adj station | USPAT; US-PGPUB | 2002/02/06 13:16 | | | 0 |
| 24 | BRS | 0 | (reflectometry and probe).clm,ab,ti. and varification adj station | USPAT; US-PGPUB | 2002/02/06 13:16 | | | 0 |
| 25 | BRS | 1 | (reflectometry and probe).clm,ab,ti. and retracting | USPAT; US-PGPUB | 2002/02/06 13:16 | | | 0 |
| 26 | BRS | 0 | differential adj domain adj reflectometry | USPAT; US-PGPUB | 2002/02/06 13:18 | | | 0 |
| 27 | BRS | 10 | differential same domain same reflectometry | USPAT; US-PGPUB | 2002/02/06 13:19 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 1 | BRS | 0 | robotic adj arm and domain adj reflectometry and high adj frequency adj probe | USPAT; US-PGPUB | 2002/02/25 18:05 | | | 0 |
| 2 | BRS | 0 | (robotic adj arm) and (domain adj reflectometry) and (high adj frequency adj probe) | USPAT; US-PGPUB | 2002/02/06 13:01 | | | 0 |
| 3 | BRS | 1 | (robotic adj arm) and (domain adj reflectometry) | USPAT; US-PGPUB | 2002/02/06 13:00 | | | 0 |
| 4 | BRS | 0 | (domain adj reflectometry) and (high adj frequency adj probe) | USPAT; US-PGPUB | 2002/02/06 13:18 | | | 0 |
| 5 | BRS | 0 | (domain same reflectometry) and (high adj frequency adj probe) | USPAT; US-PGPUB | 2002/02/06 13:01 | | | 0 |
| 6 | BRS | 0 | reflectometry and (high adj frequency adj probe) | USPAT; US-PGPUB | 2002/02/06 13:02 | | | 0 |
| 7 | BRS | 0 | robotic adj domain adj reflectometry and high adj frequency adj probe | USPAT; US-PGPUB | 2002/02/06 13:06 | | | 0 |
| 8 | BRS | 0 | robotic adj domain adj reflectometry and probe | USPAT; US-PGPUB | 2002/02/06 13:03 | | | 0 |
| 9 | BRS | 335 | reflectometry and probe | USPAT; US-PGPUB | 2002/02/06 13:03 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 10 | BRS | 45 | (reflectometry and probe).clm,ab,ti. | USPAT; US-PGPUB | 2002/02/06 13:21 | | | 0 |
| 11 | BRS | 12 | ((reflectometry and probe).clm,ab,ti.) and high adj frequency | USPAT; US-PGPUB | 2002/02/06 13:05 | | | 0 |
| 12 | BRS | 0 | robotic adj domain adj reflectometry | USPAT; US-PGPUB | 2002/02/06 13:06 | | | 0 |
| 13 | BRS | 22 | (reflectometry and probe).clm,ab,ti. and calibration | USPAT; US-PGPUB | 2002/02/06 13:15 | | | 0 |
| 14 | BRS | 6 | (reflectometry and probe).clm,ab,ti. and traces | USPAT; US-PGPUB | 2002/02/06 13:10 | | | 0 |
| 15 | BRS | 0 | (reflectometry and probe).clm,ab,ti. and traces and arm | USPAT; US-PGPUB | 2002/02/06 13:10 | | | 0 |
| 16 | BRS | 11 | (reflectometry and probe).clm,ab,ti. and arm | USPAT; US-PGPUB | 2002/02/06 13:12 | | | 0 |
| 17 | BRS | 0 | (reflectometry and probe).clm,ab,ti. and robotic adj arm | USPAT; US-PGPUB | 2002/02/06 13:12 | | | 0 |
| 18 | BRS | 0 | (reflectometry and probe).clm,ab,ti. and arm and high adj frequency | USPAT; US-PGPUB | 2002/02/06 13:13 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 28 | BRS | 3 | differential with domain same reflectometry | USPAT; US-PGPUB | 2002/02/06 13:19 | | | 0 |
| 29 | BRS | 24 | (reflectometry and probe).clm,ab,ti. and impedance | USPAT; US-PGPUB | 2002/02/06 13:22 | | | 0 |
| 30 | BRS | 5 | ((reflectometry and probe).clm,ab,ti. and impedance) not ((reflectometry and probe).clm,ab,ti. and impedance and delay) | USPAT; US-PGPUB | 2002/02/06 13:22 | | | 0 |
| 31 | BRS | 19 | (reflectometry and probe).clm,ab,ti. and impedance and delay | USPAT; US-PGPUB | 2002/02/06 13:23 | | | 0 |
| 32 | BRS | 120 | 324/643.ccls. | USPAT; US-PGPUB | 2002/02/21 18:00 | | | 0 |
| 33 | BRS | 0 | 324/643.ccls. and reflectometry adj testing | USPAT; US-PGPUB | 2002/02/21 18:00 | | | 0 |
| 34 | BRS | 9 | reflectometry adj testing | USPAT; US-PGPUB | 2002/02/21 18:03 | | | 0 |
| 35 | BRS | 9 | reflectometry near testing | USPAT; US-PGPUB | 2002/02/21 18:07 | | | 0 |
| 36 | BRS | 20 | reflectometry near3 testing | USPAT; US-PGPUB | 2002/02/21 18:03 | | | 0 |

|  | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 37 | BRS | 1 | (reflectometry near3 testing).ab. | USPAT; US-PGPUB | 2002/02/21 18:04 |  |  | 0 |
| 38 | BRS | 1 | (reflectometry near3 testing).ti. | USPAT; US-PGPUB | 2002/02/21 18:05 |  |  | 0 |
| 39 | BRS | 2 | domain near reflectometry near instrumentation | USPAT; US-PGPUB | 2002/02/21 18:11 |  |  | 0 |
| 40 | BRS | 3 | ("4991915" \| "5059914" \| "5554936").PN. | USPAT; US-PGPUB | 2002/02/21 18:09 |  |  | 0 |
| 41 | BRS | 2 | 5781019.URPN. | USPAT; US-PGPUB | 2002/02/21 18:10 |  |  | 0 |
| 42 | BRS | 4 | domain near reflectometry near instrument | USPAT; US-PGPUB | 2002/02/21 18:13 |  |  | 0 |
| 43 | BRS | 2 | domain near reflectometry near instrument and high near frequency | USPAT; US-PGPUB | 2002/02/21 18:19 |  |  | 0 |
| 44 | BRS | 0 | differential near domain near reflectometry near instrument and high near frequency | USPAT; US-PGPUB | 2002/02/21 18:20 |  |  | 0 |
| 45 | BRS | 0 | differential near domain near reflectometry | USPAT; US-PGPUB | 2002/02/21 18:20 |  |  | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 46 | IS&R | 12 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526")).PN. | USPAT; US-PGPUB | 2002/02/21 18:39 | | | 0 |
| 47 | BRS | 1 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526")).PN.) and reflectometry | USPAT; US-PGPUB | 2002/02/21 18:39 | | | 0 |
| 48 | BRS | 3 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526")).PN.) and high near frequency | USPAT; US-PGPUB | 2002/02/21 18:40 | | | 0 |
| 49 | BRS | 4 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909")).PN.) and high near frequency | USPAT; US-PGPUB | 2002/02/21 18:51 | | | 0 |
| 50 | IS&R | 13 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909")).PN. | USPAT; US-PGPUB | 2002/02/21 18:51 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 51 | BRS | 1 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909")).PN.) and reflectometry | USPAT; US-PGPUB | 2002/02/21 18:51 | | | 0 |
| 52 | BRS | 446 | swart.in. | EPO; JPO; DERWENT | 2002/02/21 18:43 | | | 0 |
| 53 | BRS | 2 | swart.in. and time near domain | EPO; JPO; DERWENT | 2002/02/21 18:46 | | | 0 |
| 54 | BRS | 314 | time near domain near reflectometry | EPO; JPO; DERWENT | 2002/02/21 18:46 | | | 0 |
| 55 | BRS | 0 | time near domain near reflectometry near tester | EPO; JPO; DERWENT | 2002/02/21 18:46 | | | 0 |
| 56 | IS&R | 14 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978")).PN. | USPAT; US-PGPUB | 2002/02/21 18:53 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 57 | BRS | 1 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978")).PN.) and reflectometry | USPAT; US-PGPUB | 2002/02/21 18:51 | | | 0 |
| 58 | BRS | 4 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978")).PN.) and high near frequency | USPAT; US-PGPUB | 2002/02/21 18:52 | | | 0 |
| 59 | IS&R | 18 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978")).PN. | USPAT; US-PGPUB | 2002/02/24 14:31 | | | 0 |
| 60 | BRS | 5 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978")).PN.) and pitch | USPAT; US-PGPUB | 2002/02/21 19:02 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 61 | IS&R | 18 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978")).PN. | USPAT; US-PGPUB | 2002/02/24 14:53 | | | 0 |
| 62 | IS&R | 1 | ("6051978").PN. | USPAT; US-PGPUB | 2002/02/24 14:31 | | | 0 |
| 63 | IS&R | 21 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN. | USPAT; US-PGPUB | 2002/02/25 13:11 | | | 0 |
| 64 | BRS | 0 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and adjustable near pitch | USPAT; US-PGPUB | 2002/02/24 14:57 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 65 | BRS | 5 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and pitch | USPAT; US-PGPUB | 2002/02/24 15:12 | | | 0 |
| 66 | BRS | 1 | (((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and pitch) and high near frequency | USPAT; US-PGPUB | 2002/02/24 15:18 | | | 0 |
| 67 | BRS | 2 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and calibration | USPAT; US-PGPUB | 2002/02/24 15:21 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 68 | BRS | 3 | "5781019" | USPAT; US-PGPUB | 2002/02/24 15:21 | | | 0 |
| 69 | IS&R | 21 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN. | USPAT; US-PGPUB | 2002/02/25 15:31 | | | 0 |
| 70 | BRS | 4 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and ohms | USPAT; US-PGPUB | 2002/02/25 13:23 | | | 0 |
| 71 | BRS | 427 | probe near2 changing | USPAT; US-PGPUB | 2002/02/25 13:23 | | | 0 |
| 72 | BRS | 178 | probe near changing | USPAT; US-PGPUB | 2002/02/25 13:24 | | | 0 |
| 73 | BRS | 0 | probe near changing near assembly and 324/$.ccls. | USPAT; US-PGPUB | 2002/02/25 13:24 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 74 | BRS | 80 | probe near changing and assembly | USPAT; US-PGPUB | 2002/02/25 13:24 | | | 0 |
| 75 | BRS | 1 | probe near changing near assembly | USPAT; US-PGPUB | 2002/02/25 13:24 | | | 0 |
| 76 | BRS | 55 | probe near changing and 324/$.ccls. | USPAT; US-PGPUB | 2002/02/25 13:44 | | | 0 |
| 77 | BRS | 1 | 5471148.pn. | USPAT; US-PGPUB | 2002/02/25 14:51 | | | 0 |
| 78 | IS&R | 21 | (("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN. | USPAT; US-PGPUB | 2002/02/25 15:31 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 79 | BRS | 2 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and calibration | USPAT; US-PGPUB | 2002/02/25 15:32 | | | 0 |
| 80 | BRS | 1 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and nist | USPAT; US-PGPUB | 2002/02/25 15:33 | | | 0 |
| 81 | BRS | 0 | ((("4593820") or ("4628464") or ("5105147") or ("5469064") or ("5498964") or ("5498965") or ("5631856") or ("5696450") or ("5781021") or ("5844412") or ("6008636") or ("6024526") or ("5994909") or ("6051978") or ("5068614") or ("5781019") or ("6247362") or ("5586054") or ("6051978") or ("4881863") or ("5043901") or ("5394348") or ("6024526")).PN.) and airline | USPAT; US-PGPUB | 2002/02/25 15:34 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 82 | BRS | 0 | calibrated near2 airline and TDR | USPAT; US-PGPUB | 2002/02/25 15:35 | | | 0 |
| 83 | BRS | 0 | calibrated near2 airline | USPAT; US-PGPUB | 2002/02/25 15:35 | | | 0 |
| 84 | BRS | 2 | calibration near2 airline | USPAT; US-PGPUB | 2002/02/25 15:35 | | | 0 |
| 85 | BRS | 180 | (TDR or reflectometry) and standard adj deviation | USPAT; US-PGPUB | 2002/02/25 15:49 | | | 0 |
| 86 | BRS | 20 | ((TDR or reflectometry) and standard adj deviation) and ohms | USPAT; US-PGPUB | 2002/02/25 15:41 | | | 0 |
| 87 | BRS | 17 | (TDR or reflectometry) and (standard adj deviation) and feet | USPAT; US-PGPUB | 2002/02/25 16:02 | | | 0 |
| 88 | BRS | 180 | (TDR or reflectometry) and (standard adj deviation) | USPAT; US-PGPUB | 2002/02/25 16:02 | | | 0 |
| 89 | BRS | 172 | (TDR or reflectometry) and impedances same ohms | USPAT; US-PGPUB | 2002/02/25 16:03 | | | 0 |
| 90 | BRS | 34 | (TDR or reflectometry) and impedances same ohms same less | USPAT; US-PGPUB | 2002/02/25 16:18 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 91 | BRS | 3 | (TDR or reflectometry) and impedances same ohms near less | USPAT; US-PG PUB | 2002/02/25 16:03 | | | 0 |
| 92 | BRS | 399 | (TDR or reflectometry) and inches | USPAT; US-PG PUB | 2002/02/25 16:19 | | | 0 |
| 93 | BRS | 6 | (TDR or reflectometry) and "36" adj inches | USPAT; US-PG PUB | 2002/02/26 10:56 | | | 0 |
| 94 | BRS | 3 | (TDR or reflectometry) and impedence and delay and dielectric | USPAT; US-PG PUB | 2002/02/25 16:48 | | | 0 |
| 95 | BRS | 34 | (TDR or reflectometry) and calculates same dielectric | USPAT; US-PG PUB | 2002/02/25 16:48 | | | 0 |
| 96 | BRS | 26 | (TDR or reflectometry) and calculates same dielectric adj constant | USPAT; US-PG PUB | 2002/02/25 16:48 | | | 0 |
| 97 | BRS | 16 | (TDR or reflectometry) and calculates same dielectric adj constant and impedance | USPAT; US-PG PUB | 2002/02/25 16:49 | | | 0 |
| 98 | BRS | 11 | (TDR or reflectometry) and calculates same dielectric adj constant and impedance and delay | USPAT; US-PG PUB | 2002/02/25 16:49 | | | 0 |
| 99 | BRS | 4 | (TDR or reflectometry) and calculates same dielectric adj constant and impedance and delay and (record or computer) | USPAT; US-PG PUB | 2002/02/25 16:49 | | | 0 |

| | Type | Hits | Search Text | DBs | Time Stamp | Comments | Error Definition | Errors |
|---|---|---|---|---|---|---|---|---|
| 100 | BRS | 34 | differential near domain | USPAT; US-PGPUB | 2002/02/25 17:22 | | | 0 |
| 101 | BRS | 8 | air adj line same ("28" or "50") near ohms | USPAT; US-PGPUB | 2002/02/25 18:06 | | | 0 |
| 102 | BRS | 2 | air adj line same ("28" or "50") near ohms and TDR | USPAT; US-PGPUB | 2002/02/25 18:06 | | | 0 |
| 103 | BRS | 298 | (TDR or reflectometry) and length and trace | USPAT; US-PGPUB | 2002/02/26 10:57 | | | 0 |
| 104 | BRS | 85 | (TDR or reflectometry) and length same trace | USPAT; US-PGPUB | 2002/02/26 10:57 | | | 0 |
| 105 | BRS | 20 | (TDR or reflectometry) and length same trace and 324/$.ccls. | USPAT; US-PGPUB | 2002/02/26 11:00 | | | 0 |
| 106 | BRS | 4 | (TDR or reflectometry) and length same trace and 324/$.ccls. and feet | USPAT; US-PGPUB | 2002/02/26 11:00 | | | 0 |

EAST Browser - L2: (34) differential . | US 4152642 A | Tag S | Doc 33/34 | "Full" 5/13 (Total images 13)

File Edit View Tools Window Help

Courier New 12

DOCUMENT-IDENTIFIER: US 4152642 A
TITLE: Signal analysis

BSPR:
By using this range pair determination of differential domains, it is now possible to effect a very simple frequency analysis of a signal.

DRPR:
FIG. 6 illustrates in more detail the interconnection for commercial integrated circuits for a differential domain generator,

DEPR:
FIG. 6 is the circuit of the differential domain generator. The "DP", domain penultimate outputs, 95 of memory elements 75 through 80 are connected through inverters, 96 through 101, to the "B" inputs 102 of two adders 103 and 104, both type CD4008C, configured as a 6 bit adder, 105.

DEPR:
A last domain output "D", 106 is connected to the A inputs of adder 105.
Outputs 108 of the adder 105 are connected to inputs, 109, of two registers,
110 and 111, both type MM74C95, configured as an 8 bit parallel in/parallel out
register 112. Clock left inputs 1101 and 1111 of register 112 are connected to
memory clock left input CL. Output "DD", differential domain 113 is the main
signal output of the analyser. Output 111C is used to indicate sign (or

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 27 | US 5063574 A | | USPAT | 19911105 | 23 | Mul |
| 28 | US 5004918 A | | USPAT | 19910402 | 10 | Dif |
| 29 | US 4981359 A | | USPAT | 19910101 | 17 | Rin |
| 30 | US 4871987 A | | USPAT | 19891003 | 7 | FSK |
| 31 | US 4786150 A | | USPAT | 19881122 | 6 | Zoo |
| 32 | US 4371907 A | | USPAT | 19830201 | 16 | Pro |
| 33 | US 4152642 A | | USPAT | 19790501 | 13 | Sig |



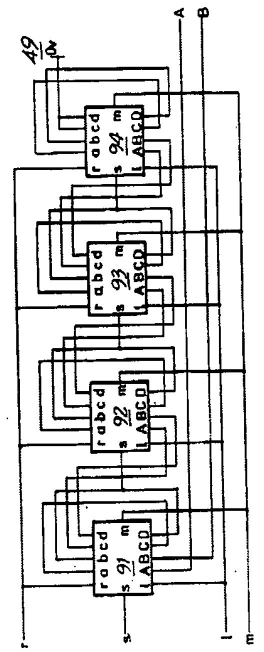


FIG. 5

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differential
domain

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DOCUMENT-IDENTIFIER: US 4152642 A
TITLE: Signal analysis

BSPR:
By using this range pair determination of differential domains, it is now possible to effect a very simple frequency analysis of a signal.

DRPR:
FIG. 6 illustrates in more detail the interconnection for commercial integrated circuits for a differential domain generator,

DEPR:
FIG. 6 is the circuit of the differential domain generator. The "DP", domain penultimate outputs, 95 of memory elements 75 through 80 are connected through inverters, 96 through 101, to the "B" inputs 102 of two adders 103 and 104, both type CD4008C, configured as a 6 bit adder, 105.

DEPR:
A last domain output "D", 106 is connected to the A inputs of adder 105. Outputs 108 of the adder 105 are connected to inputs, 109, of two registers, 110 and 111, both type MM74C95, configured as an 8 bit parallel in/parallel out register 112. Clock left inputs 1101 and 1111 of register 112 are connected to memory clock left input CL. Output "DD", differential domain 113 is the main signal output of the analyser. Output 111C is used to indicate sign (or validity, S) of the "DD" output signal 113

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| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 27 | US 5063574 A | | USPAT | 19911105 | 23 | Mul |
| 28 | US 5004918 A | | USPAT | 19910402 | 10 | Dif: |
| 29 | US 4981359 A | | USPAT | 19910101 | 17 | Rin |
| 30 | US 4871987 A | | USPAT | 19891003 | 7 | FSK |
| 31 | US 4786150 A | | USPAT | 19881122 | 6 | Zoo |
| 32 | US 4371907 A | | USPAT | 19830201 | 16 | Pro |
| 33 | US 4152642 A | | USPAT | 19790501 | 13 | Sig |

324-77 SR
5/1/79 UR 4,152,642

# United States Patent [19]

Doherty

[11] 4,152,642

[45] May 1, 1979

[54] SIGNAL ANALYSIS


[76] Inventor: Leslie E. Doherty, 8 Lambrook St., Elizabeth West, S.A. 5113, Australia



[21] Appl. No.: 823,391

[22] Filed: Aug. 10, 1977

[30] Foreign Application Priority Data

Aug. 16, 1976 [AU] Australia ............ PC 6997

[51] Int. Cl.[2] ............ G01R 23/16

[52] U.S. Cl. ............ 324/77 A; 328/116

[58] Field of Search ............ 324/77 R, 77 A, 103 P, 324/133; 328/116, 117; 307/235 C, 235 P



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Primary Examiner—M. Tokar

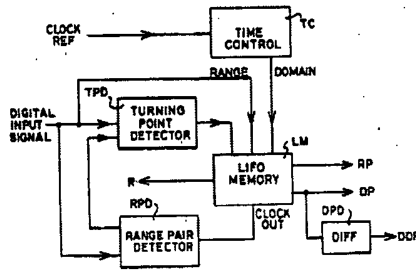
Attorney, Agent, or Firm—Kinzer, Plyer, Dorn & McEachran



[57] ABSTRACT

A method of signal analysis in which the signal in digital form has range values and domain values at successive turning points of range values stored in a memory; upon the signal passing through a penultimate stored value of range, the last two stored values of range and associated domain values are extracted for separate use and are deleted from the memory and hence from subsequent comparisons.


10 Claims, 8 Drawing Figures




differential
domain

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Courier New 12

absolute
deviation) of the waveform as shown in step 138. The average deviation differs
slightly from standard deviation in that the average deviation is less
susceptible to outlier data points than the standard deviation . The average
deviation is give by the following equation: ##EQU1##

DEPR:
The width of an event is a function of the pulsewidth of the interrogating
pulse. Events farther out in the cable tend to be wider than events closer to
the instrument. The width of an event also increases as a function of the
receiver gain. The width of the event increases along with the receiver gain.
For these reasons, distance and gain dependent factors are used for estimating
the width of the event and the end point of the event. If the distance of the
event is less than 50 feet from the instrument, the distance factor is 1. From
50 feet to less than 100 feet, the distance factor is factor is 1.5. From 100
feet to less than 400 feet, the distance factor is 1.5 and so on as shown in
Table 1. The gain factor table takes into account the pulse width of the
interrogating pulses and the gain of the receiver. In the preferred embodiment
of the invention, the pulsewidth PW0=4.00 nanoseconds, pulsewidth PW1=6.00
nanoseconds, and pulsewidth PW2=25.00 nanoseconds. Other interrogating
pulsewidths may be used with corresponding changes to the distance and gain
factor tables without departing from the scope of the present

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US 5870451 A USPAT 19990209 24

US006195614B1

(12) **United States Patent**
**Kochan**

(10) **Patent No.:** **US 6,195,614 B1**
(45) **Date of Patent:** **Feb. 27, 2001**

(54) METHOD OF CHARACTERIZING EVENTS IN ACQUIRED WAVEFORM DATA FROM A METALLIC TRANSMISSION CABLE

(75) Inventor: **Phillip F. Kochan**, Redmond, OR (US)

(73) Assignee: **Tektronix, Inc.**, Beaverton, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/054,369**

(22) Filed: **Apr. 2, 1998**

**Related U.S. Application Data**

(60) Provisional application No. 60/048,247, filed on Jun. 2, 1997.

(51) Int. Cl.[7] .......... G01R 13/00; G01R 31/11; G06F 19/00

(52) U.S. Cl. .......... 702/66; 702/59; 324/533; 324/534

(58) Field of Search .......... 702/57-59, 65-71, 702/73, 74, 81, 79, 115-124, 126, 182, 183-185, 189, 193, 199; 324/76.2, 533, 534; 370/252

(56) **References Cited**

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| 5,373,356 | | 12/1994 | Anderson | 356/73.1 |
| 5,440,528 | | 8/1995 | Walsh | 368/113 |
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| 5,528,356 | | 6/1996 | Harcourt | 356/73.1 |
| 5,530,367 | | 6/1996 | Bottman | 324/616 |

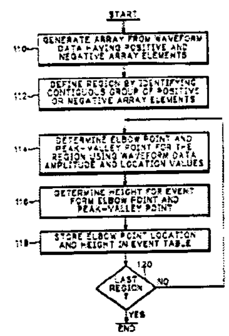
* cited by examiner

*Primary Examiner*—Marc S. Hoff
*Assistant Examiner*—Manuel L. Barbee
(74) *Attorney, Agent, or Firm*—William K. Bucher; Francis I. Gray

(57) **ABSTRACT**


A method for characterizing events in acquired time domain reflectometry data from a metallic cable under test uses an edge or event detector for generating an array where positive array elements represent a positive leading edge of an event and negative array elements represent a negative leading edge of an event. Predominantly contiguous groups of positive and negative array elements are identified for defining regions, and elbow points and peak-valley points are determined for the regions having location and amplitude values corresponding to one of the waveform data points. The height for the event is determined as a function of the elbow point and the peak-valley point, and elbow point representing the location of the event and the event height are stored. The edge detector covers a defined number of waveform data points and moves over the waveform data point by point averaging the data within the detector, calculating an estimated noise characteristic and determining top and bottom threshold values at each data point. The thresholds are calculated as the estimated noise characteristic times a constant above the averaged waveform data within the detector. The elbow point is determined as the maximum deviation of the waveform data point from a line defined in relation to the peak-valley point and a point prior to the region in the waveform data.


**13 Claims, 11 Drawing Sheets**

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Standard deviation

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DEPR:
The data set out in FIG. 4 represent the correlation of the TLC response (the summation of the green filter reflectance and the red filter reflectance) with that of the probe embedded in the table adjacent to the affixed TLC material. From FIG. 4 it can be determined that even under rapidly fluctuating temperatures there is good correlation between the temperatures recorded by the probe and those which are recorded by the TLC. Under these rapidly fluctuating environmental conditions the correlation between the TLC and the probe measuring the ambient air temperature were less robust. FIG. 3 correlates the TLC recorded temperature to that of the table temperature probe. The correlation shows a R.sup.2 of 0.998 and a Sy.X (standard deviation of the line) of 0.203 where R.sup.2 is the squared regression coefficient which shows the correlation between two measurements with the value of 1 demonstrating a perfect correlation with a value of 0 demonstrating no correlation at all between the two measurements. This indicates that within a 95% confidence limit, the correlation between the TLC and table probe is within half a degree.

DEPR:
As indicated by Table 1, a significant reduction in the error (in terms of standard deviation ) on the order of about 4-fold is achieved

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U.S. Patent Oct. 26, 1999 Sheet 2 of 4 5,972,715

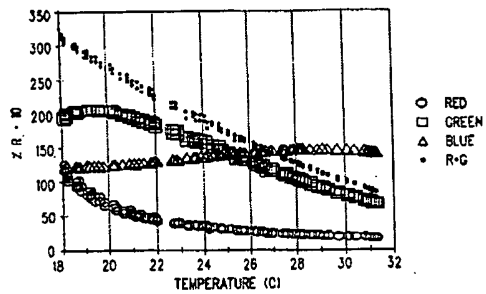


FIG 3

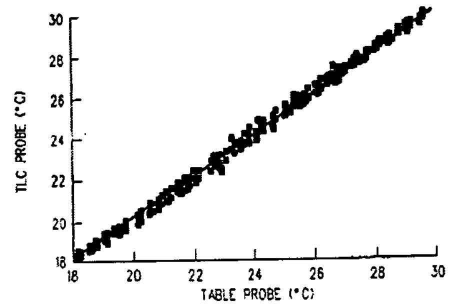


FIG 4

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standard deviation

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the signal along the probe is then used to determine the dielectric constant of the fluid.

BSPR:
A number of proposals have been made for determining the dielectric constant of a fluid. For example, U.S. Pat. No. 3,812,422 describes a method that measures a dielectric constant based upon an amplitude of a reflected signal that reflects from an interface between different media such as air and fluid. The amplitude of the reflected signal provides impedance information that then is utilized to calculate the dielectric constant .

BSPR:
In the preferred embodiment, the device of this invention is used to determine a level of the fluid that is under investigation. A signal propagated along the probe reflects back toward the signal receiver when the signal encounters the interface between air and the fluid. There is a reflection because the impedance of the fluid is different than the impedance of the air. The signal continues down the length of the probe to the end of the probe immersed in the fluid. A second reflection occurs at the end of the probe because the end of the probe represents a very high impedance . The time when the reflection at the air/fluid interface occurs and the time when the reflection from the end of the probe occurs are both determined. Those two times and a calibration factor

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|---|---|---|---|---|---|---|
| 1 | US 5898308 A | | USPAT | 19990427 | 8 | Time- |
| 2 | US 5631562 A | | USPAT | 19970520 | 16 | Time |
| 3 | US 5581019 A | | USPAT | 19961203 | 24 | Gaske |
| 4 | US 5524281 A | | USPAT | 19960604 | 182 | Appar |

US005898308A

# United States Patent [19]

Champion

[11] Patent Number: 5,898,308

[45] Date of Patent: Apr. 27, 1999

[54] TIME-BASED METHOD AND DEVICE FOR DETERMINING THE DIELECTRIC CONSTANT OF A FLUID


[75] Inventor: James R. Champion, Sarasota, Fla.

[73] Assignee: Teleflex Incorporated, Plymouth Meeting, Pa.



[21] Appl. No.: 08/938,988

[22] Filed: Sep. 26, 1997

[51] Int. Cl.[6] ........ G01R 27/04; G01N 22/00; G01F 23/00

[52] U.S. Cl. ........ 324/643; 324/642; 73/304 R

[58] Field of Search ........ 324/633, 634, 324/637, 642, 643, 71.1; 73/290 R, 304 R, 304 C



[56] References Cited

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5,459,403 10/1995 Kohler et al. ........ 324/643
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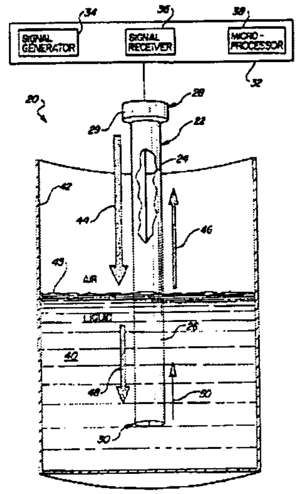
Primary Examiner—Diep N. Do
Attorney, Agent, or Firm—Howard & Howard


[57] ABSTRACT

A device utilizes micropower, impulse radar and time domain reflectometry to determine the dielectric constant of a fluid. An electrically conductive probe preferably in the form of a transmission line, is inserted at least partially into the fluid. The device includes a signal generator that generates an impulse signal that is propagated along the probe. The time that it takes for the signal to reach the end of the probe is determined. The time of travel of the signal along the probe is then used to determine the dielectric constant of the fluid.


20 Claims, 3 Drawing Sheets

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cases, a TDR
measurement is adequate to provide a characteristic impedance
of a transmission
line and to locate discontinuities along the transmission
line. However, TDR
measurements provide only magnitude versus time information
using analog
techniques. As a pulse is launched, an analog trace is swept
along a
horizontal display, deflected vertically by the voltage level
of the reflected
signal. Such traditional TDR techniques do not measure
impedance versus
frequency of the DUT, but rather display only its pulse
response. Therefore,
it would be desirable to provide a low cost, portable,
pulse-based impedance
measurement instrument that measures complex impedance and
return loss.

DEPR:
FIGS. 6A-C are graphs that illustrate example results from
the overall
measurement process when an unknown DUT is coupled to the
instrument connector
74. In this example, a DUT 52 in the form of a twisted wire
pair transmission
line 12 consisting of single segment 16 with a length of 50
... is coupled to
the impedance measurement instrument 10. The pulse response
of the
transmission line 12 is shown in FIG. 6A, a calculated
impedance versus
frequency measurement based on the transmission line pulse
response and the
calibration constants is shown in FIG. 6B, and the calculated
return loss
versus frequency based on the impedance versus frequency

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US005633801A

# United States Patent [19]

[11] Patent Number: 5,633,801

[45] Date of Patent: May 27, 1997

Bottman

[54] PULSE-BASED IMPEDANCE MEASUREMENT INSTRUMENT

[75] Inventor: Jeffrey S. Bottman, Seattle, Wash.

[73] Assignee: Fluke Corporation, Everett, Wash.

[21] Appl. No.: 540,927

[22] Filed: Oct. 11, 1995

[51] Int. Cl.[6] ........ G01R 27/16

[52] U.S. Cl. ........ 364/482; 364/571.01; 364/571.04; 324/600

[58] Field of Search ........ 364/481-482, 364/484, 486, 571.01, 571.02, 571.04; 324/512, 519-522, 525, 527, 600, 601, 612, 615-617, 638-639, 641, 649, 650, 654, 658

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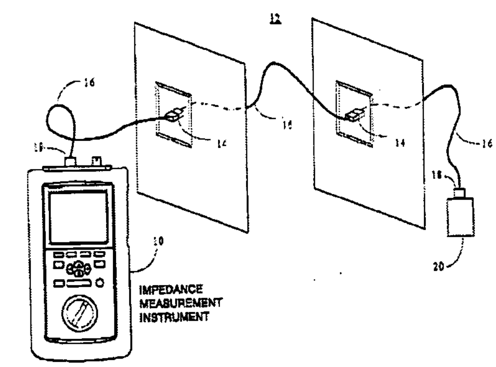
"RF Impedance Measurements by Voltage-Current Detection", Ichiro Yokoshima, IEEE Trans. Instrumentation & Measurement, vol. 42, No. 2, pp. 524-527 Apr. 1993.

*Primary Examiner*—Ellis B. Ramirez
*Assistant Examiner*—Tuan Q. Dam
*Attorney, Agent, or Firm*—Douglas J. Barker

[57] ABSTRACT

In accordance with the present invention, a pulse-based impedance measurement instrument is provided. A pulse generator repetitively generates a stimulus pulse to a device under test (DUT). A digitizer circuit, consisting of a sample-and-hold circuit, an analog to digital converter, and acquisition memory, repetitively samples the response voltage across the DUT to create a time record of the voltage as a function of time during a pulse response measurement. Each time record is operated on by a Fast Fourier Transform (FFT) which converts the voltage versus time information into voltage versus frequency information in a manner well known in the art. By measuring a set of calibration resistors with known resistance values to generate a set of complex calibration constants, the impedance measurement instrument provides measurements of complex impedance and return loss versus frequency of a DUT.

8 Claims, 7 Drawing Sheets



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subscribers, each on average
several miles from the central office. As a result, there are millions of
linear feet of subscriber lines. When a fault occurs, before it can be
repaired, it must first be located within this millions of feet of wires.

BSPR:
When a fault is detected, the telephone company dispatches a repair person to
find and fix the fault. Historically, telephone companies have employed three
types of repair people: those who repair faults in the central office; those
who repair faults in cables routing the pairs of subscriber lines around the
telephone company's service area; and those repairing faults at the "station."
The station refers to the subscriber line as it leaves the cable and runs into
the customer's premises. The different types of repair people carry different
types of equipment and have different types of training geared towards the
types of conditions they are likely to encounter. For example, a repair person
dispatched to repair a cable might carry a time domain reflectometry (TDR )
unit. This unit is connected to a telephone line and transmits an electrical
pulse down the line. When the pulse reaches an open circuit or a short circuit
fault, it is reflected back towards the TDR unit. By measuring the time it
takes for the pulse to travel back and forth to the fault, the distance between
the fault and repair person can be computed. In this way, faults can be

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| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 6026145 A | | USPAT | 20000215 | 24 | Methc |
| 2 | US 5870451 A | | USPAT | 19990209 | 24 | Methc |
| 3 | US 5633801 A | | USPAT | 19970527 | 14 | Pulse |
| 4 | US 5631562 A | | USPAT | 19970520 | 16 | Time |

US006026145A

# United States Patent [19]

Bauer et al.

[11] Patent Number: 6,026,145

[45] Date of Patent: Feb. 15, 2000

[54] METHOD AND APPARATUS FOR FAULT SEGMENTATION IN A TELEPHONE NETWORK

[76] Inventors: Frank R. Bauer, 2232 Shiloh Dr., Long Grove, Ill. 60047; Kurt E. Schmidt, 6444 Brever Rd., Burlington, Wis. 53105; David J. Groessl, 306 Meredeth Pl., Vernon Hills, Ill. 60061

[21] Appl. No.: 09/211,338

[22] Filed: Dec. 14, 1998

Related U.S. Application Data

[62] Division of application No. 08/965,360, Nov. 6, 1997, Pat. No. 5,870,451, which is a division of application No. 08/311,802, Sep. 26, 1994, Pat. No. 5,699,402.

[51] Int. Cl.[7] ........ H04M 1/24

[52] U.S. Cl. ........ 379/26; 379/29; 324/533; 324/523

[58] Field of Search ........ 379/22, 24, 26, 379/27, 29, 30, 32; 324/522, 523, 532, 533, 534

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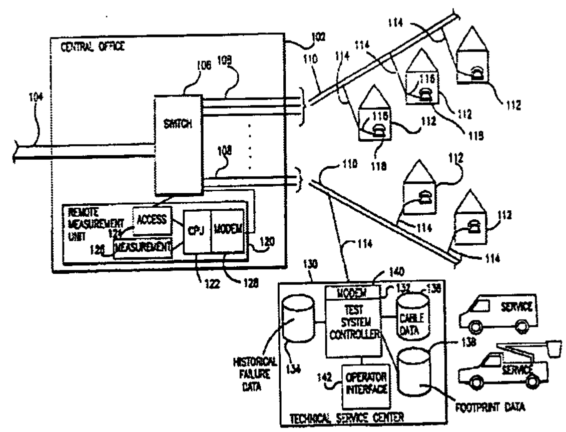
| 5,606,592 | 2/1997 | Galloway et al. | 379/30 |

Primary Examiner—Paul Loomis
Attorney, Agent, or Firm—David W. Rouille

[57] ABSTRACT

An automated telephone line test system that is well suited for determining the location of faults within a telephone network. The telephone line test system uses time domain reflectometry to aid in locating the faults. The time domain reflectometry unit is connected through a switch in the network so that the time domain reflectometry unit can be connected to multiple lines without human intervention. Parameters of the time domain reflectometry signals are controlled so that reflections from the switch do not interfere with measurement of parameters on the faulty line.

15 Claims, 8 Drawing Sheets

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are millions of
linear feet of subscriber lines. When a fault occurs,
before it can be
repaired, it must first be located within this millions of
feet of wires.

BSPR:
When a fault is detected, the telephone company dispatches a
repair person to
find and fix the fault. Historically, telephone companies
have employed three
types of repair people: those who repair faults in the
central office; those
who repair faults in cables routing the pairs of subscriber
lines around the
telephone company's service area; and those repairing faults
at the "station."
The station refers to the subscriber line as it leaves the
cable and runs into
the customer's premises. The different types of repair
people carry different
types of equipment and have different types of training
geared towards the
types of conditions they are likely to encounter. For
example, a repair person
dispatched to repair a cable might carry a time domain
reflectometry (TDR )
unit. This unit is connected to a telephone line and
transmits an electrical
pulse down the line. When the pulse reaches an open circuit
or a short circuit
fault, it is reflected back towards the TDR unit. By
measuring the time it
takes for the pulse to travel back and forth to the fault,
the distance between
the fault and repair person can be computed. In this way,
faults can be
located to within a section of cable.

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 6026145 A | | USPAT | 20000215 | 24 | Methc |
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| 3 | US 5633801 A | | USPAT | 19970527 | 14 | Pulse |
| 4 | US 5631562 A | | USPAT | 19970520 | 16 | Time |

US006026145A

# United States Patent [19]

Bauer et al.

[11] Patent Number: 6,026,145

[45] Date of Patent: Feb. 15, 2000

[54] METHOD AND APPARATUS FOR FAULT SEGMENTATION IN A TELEPHONE NETWORK

[76] Inventors: Frank R. Bauer, 2232 Shiloh Dr., Long Grove, Ill. 60047; Kurt E. Schmidt, 6444 Brever Rd., Burlington, Wis. 53105; David J. Groessl, 306 Meredeth Pl., Vernon Hills, Ill. 60061

[21] Appl. No.: 09/211,338

[22] Filed: Dec. 14, 1998

Related U.S. Application Data

[62] Division of application No. 08/965,360, Nov. 5, 1997, Pat. No. 5,870,451, which is a division of application No. 08/311,802, Sep. 26, 1994, Pat. No. 5,699,402.

[51] Int. Cl.$^7$ .......... H04M 1/24

[52] U.S. Cl. .......... 379/26; 379/29; 324/533; 324/523

[58] Field of Search .......... 379/22, 24, 26, 379/27, 29, 30, 32; 324/522, 523, 532, 533, 534

[56] References Cited

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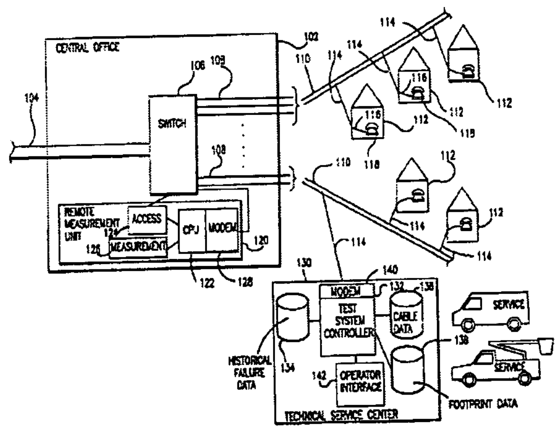
| 5,121,420 | 6/1992 | Marr et al. | 379/26 |
| 5,270,661 | 12/1993 | Burnett | 324/527 |
| 5,319,311 | 6/1994 | Kawashima | 379/26 |
| 5,606,592 | 2/1997 | Galloway et al. | 379/30 |

Primary Examiner—Paul Loomis
Attorney, Agent, or Firm—David W. Rouille

[57] ABSTRACT

An automated telephone line test system that is well suited for determining the location of faults within a telephone network. The telephone line test system uses time domain reflectometry to aid in locating the faults. The time domain reflectometry unit is connected through a switch in the network so that the time domain reflectometry unit can be connected to multiple lines without human intervention. Parameters of the time domain reflectomatry signals are controlled so that reflections from the switch do not interfere with measurement of parameters on the faulty line.

15 Claims, 8 Drawing Sheets

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EAST Browser - L4: (4) (TDR OR REFL | US 5633801 A | Tag: S | Doc: 3/4 | "Full" 3/14 (Total images 14)

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DBFR:

FIG. 6B is a calculated impedance versus frequency measurement based on the transmission line pulse response and the calibration constants. A trace 604 is the magnitude of the impedance, with the vertical axis in units of ohms and the horizontal axis in units of frequency in megahertz. The impedance of the transmission line is approximately 100 ohms across the frequency range spanning 100 megahertz but is subject to local peaks and valleys which are the result of reflections along the length of the transmission line 12 and from the connectors 14 and 18. Such reflections are the result of discontinuities from the connectors 14 and 18 as was shown in the reflected pulse 602 as well as from reflections due to impedance variations along the length of the transmission line 12. The impedance is thus calculated as explained in the process 280 shown in FIG. 4B.

CCXR:
324/600

ORPL:
"High Resolution Frequency-Domain Reflectometry ", Hugo Vanhamme, IEEE Trans Instrumentation & Measurement, vol. 39. No. 2, pp. 369-375 Apr. 1990.

Details | Text | Image | KWIC

Find

Find what: trace

Find Next | Cancel

Area: All / Sel/Cur

Direction: Up / Down

Match word: Whole / Left / Part / Right

Look in: Grid / Documents

Match case

Methc
Methc
Pulse
Time



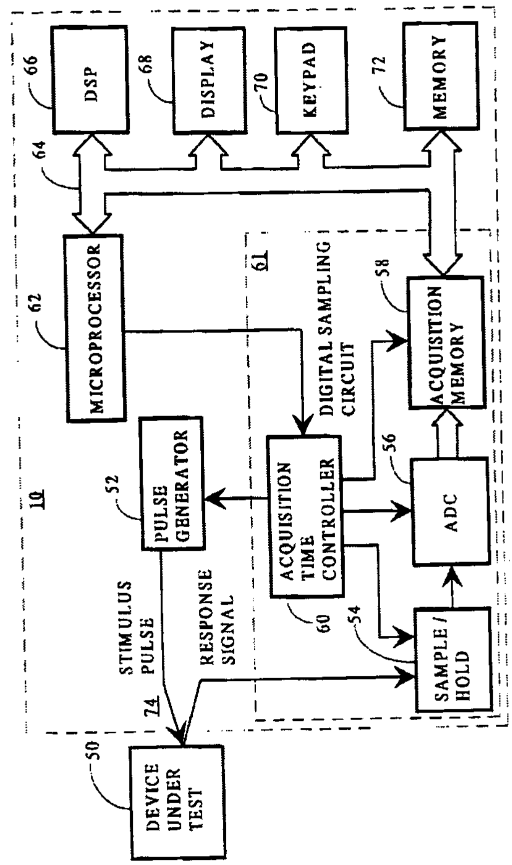


FIG. 2

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EAST Browser - L4: (1) differential... | US 5479610 | Tag: S,P,T1 | Doc: 1/1 | "Full" 3/10 (Total images 10) | Marked

File Edit View Tools Window Help

Courier New 12

DERWENT-ACC-NO: 1995-185878

DERWENT-WEEK: 199735

*COPYRIGHT 1999 DERWENT INFORMATION LTD*

TITLE: System interface fault isolator test set for interfaces found in aircraft - uses time domain reflectometry test techniques to isolate faults from one end of cable

**Basic Abstract Text - ABTX (2):**

VSWR data is obtained by processing the TDR data using software built into the maintenance control unit (2). The control unit is programmable to accommodate a variety of different system interfaces and bit status data can be downloaded directly to the control unit. Two adaptors (6) are also provided, one of which is connected to the control unit to analyse a multi-line digital bus, and the other one allows differential TDR measurements to be taken by the SI-FI on a MIL-STD-1553 bus.

Details | Text | Image | HTML | KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| | US 5479610 A | | DERWENT | 19950511 | 10 | Syste |

Details | Text | Image | HTML

U.S. Patent Dec. 26, 1995 Sheet 2 of 5 5,479,610

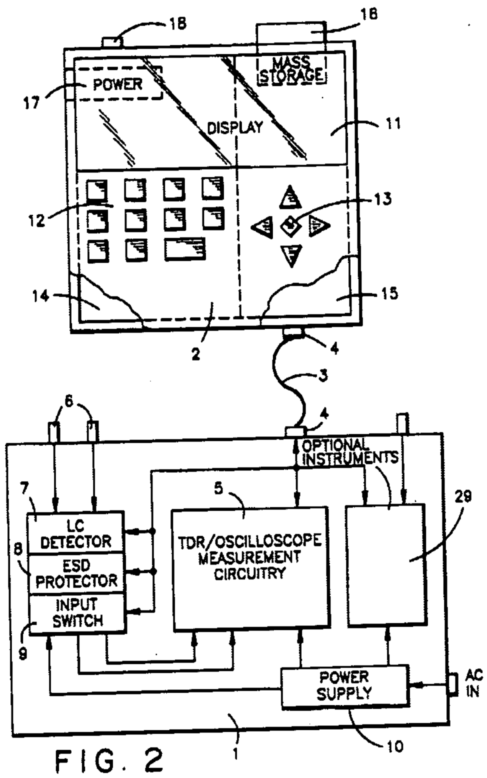


FIG. 2

Details | Text | Image | HTML | Full

09/738044

EAST Browser - L5: (5) differential... | US 5479610 | Tag: S,P,T1 | Doc: 4/5 | "Full" 4/10 (Total images 10)

File Edit View Tools Window Help

8. Apparatus as claimed in claim 1, further comprising a thru-line bus test adaptor for a parallel data bus, comprising means including a bus isolator placed between a bus controller and remote terminal for providing a signal path while DC isolating the bus controller from the remote terminal, a driver/receiver pair for each data and control line, and a reconfigurable test interface connected between the driver/receiver pairs and the maintenance control unit.

9. Apparatus as claimed in claim 1, further comprising a MIL-STD-1553 bus test adaptor which includes two identical impedance converter/delay normalization circuits connected between the time domain reflectometer and a MIL-STD-1553 bus, in order to perform differential TDR measurements on said MIL-STD-1553 bus.

10. Apparatus as claimed in claim 1, wherein said maintenance control unit and measurement unit are portable.

11. A system interface fault isolator apparatus, comprising: a portable measurement unit containing a plurality of test instruments connected by means including a bus to which additional instrument modules can be connected for performing different types of measurements on different types of interfaces;

Details | Text | Image | HTML | CLM

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 20020075009 | | US-PGPUB | 20020620 | 24 | Aut |
| 2 | US 20020053899 | | US-PGPUB | 20020509 | 65 | Met |
| 3 | US 20020053898 | | US-PGPUB | 20020509 | 63 | Mul |
| 4 | US 5479610 A | | USPAT | 19951226 | 10 | Sys |
| 5 | US 5083086 A | | USPAT | 19920121 | 11 | Dif |

Details | Text | Image | HTML



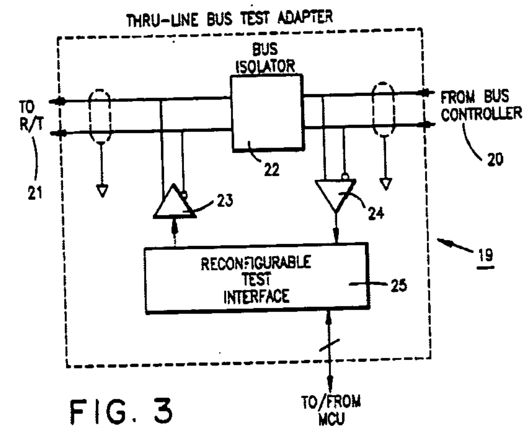


FIG. 3

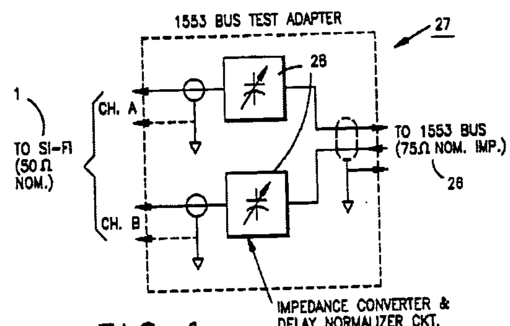


FIG. 4

Details | Text | Image | HTML | Full

EAST Browser - L5: (5) differential... | US 5479610 A | Tag: S,P,T,I | Doc: 4/5 | Format : KWIC

File Edit View Tools Window Help

requiring removal of the cable or component from the system. A separate maintenance control unit provides the processing means and the mass storage means for processing and storing reference data, test limits and test results for a plurality of systems. The maintenance control unit is programmable to accommodate a variety of different interfaces to be tested. Two adaptors are provided, one of which allows the SI-FI to test and/or control a variety of parallel digital buses, and the other of which allows differential TDR measurements to be taken by the SI-FI on a MIL-STD-1553 bus.

Drawing Description Text - DRTX (6):

FIG. 5 is a graph showing the results of differential TDR testing of a MIL-STD-1553 bus for a practical implementation of the SI-FI unit of FIG. 1.

Claims Text - CLTX (18):

9. Apparatus as claimed in claim 1, further comprising a MIL-STD-1553 bus test adaptor which includes two identical impedance converter/delay normalization circuits connected between the time domain reflectometer and a MIL-STD-1553 bus, in order to perform differential TDR measurements on said MIL-STD-1553 bus.

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| 1 | US 20020075009 | | US-PGPUB | 20020620 | 24 | Aut |
| 2 | US 20020053899 | | US-PGPUB | 20020509 | 65 | Met |
| 3 | US 20020053898 | | US-PGPUB | 20020509 | 63 | Mul |
| 4 | US 5479610 A | | USPAT | 19951226 | 10 | Sys |
| 5 | US 5083086 A | | USPAT | 19920121 | 11 | Dif |

Details Text Image HTML

U.S. Patent Dec. 26, 1995 Sheet 2 of 5 5,479,610

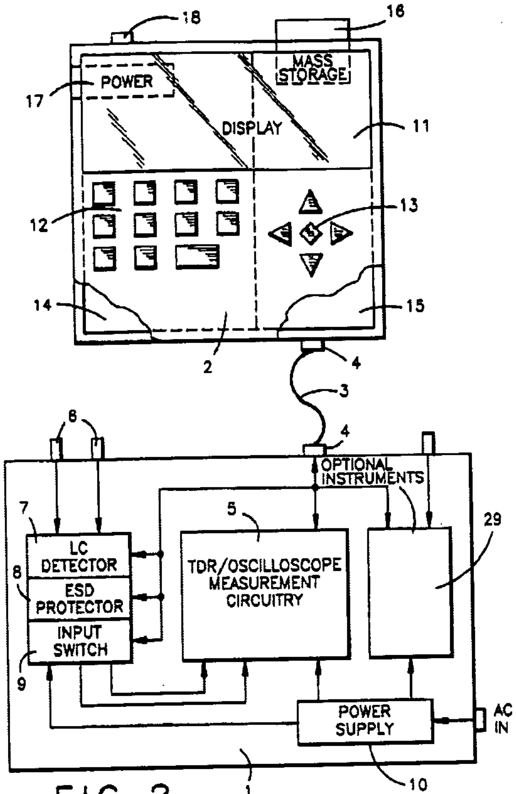


FIG. 2

Details Text Image HTML Full

A new TDR technique has recently become available and is referred to as differential TDR (DTDR). This technique allows the operator to remove nuisance reflections from the measurements. The basic idea is to use a TDR to measure the background scattering function of the cable and use it as a calibration signature of the cable to correct the measurements. The background scattering function is a signature of all the "background" discontinuities along the length of the cable under test which is usually referred to as clutter. The received, background scattering function, R.sub.bkgd (t), can be represented, using a first order model, as ##EQU3## where S(t) is the pulse that is applied to the cable, .rho..sub.i is the reflection coefficient of the i.sup.th impedance discontinuity, T.sub.i is the round-trip time delay to the i.sup.th impedance discontinuity and N is the number of significant reflectors along the cable. The DTDR technique is meant to be used in situations where a preexisting calibration for the cable is stored in an archive or where the operator has complete access to all parts of the system. Archives of the cable discontinuities often do not exist which limits the applicability of the archival technique. In the absence of an archive the DTDR technique finds its greatest use in tests where the operator determines the

Details | Text | Image | HTML | KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 20020075009 | | US-PGPUB | 20020620 | 24 | Aut |
| 2 | US 20020053899 | | US-PGPUB | 20020509 | 65 | Met |
| 3 | US 20020053898 | | US-PGPUB | 20020509 | 63 | Mul |
| 4 | US 5479610 A | | USPAT | 19951226 | 10 | Sys |
| 5 | US 5083086 A | | USPAT | 19920121 | 11 | Dif |

Details | Text | Image | HTML

US005083086A

# United States Patent [19]

Steiner

[11] Patent Number: 5,083,086

[45] Date of Patent: Jan. 21, 1992

[54] DIFFERENTIAL ARC REFLECTOMETRY

[75] Inventor: James P. Steiner, Royersford, Pa.

[73] Assignee: James G. Biddle Co., Blue Bell, Pa.

[21] Appl. No.: 552,251

[22] Filed: Jul. 12, 1990

[51] Int. Cl.[5] .......... G01R 31/11

[52] U.S. Cl. .......... 324/533; 324/534; 324/644; 379/26

[58] Field of Search .......... 324/533, 534, 536, 644; 379/26

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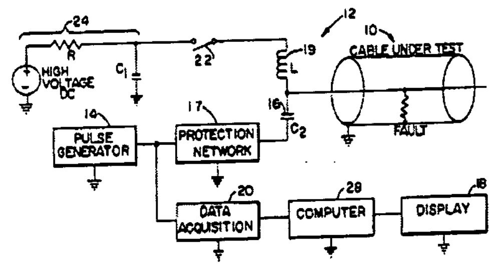
EPRI Report TD-153: "Evaluation of Underground Fault Location Techniques", Apr. 1976.
Schwarz: "Fault Location in Underground Cables"—IEEE PES Meeting—Jul. 1975.
Widrow: "Adaptive Signal Processing"—Prentice Hall—1985—Ch. 9.


Primary Examiner—Kenneth A. Wieder
Assistant Examiner—Jose M. Solis
Attorney, Agent, or Firm—Dann, Dorfman, Herrell and Skillman

[57] ABSTRACT


Location of a fault in electrical conductors from a terminal position which may be remote from the fault using at least a broad band pulse generator to generate a pulse at a terminal position. It also uses a voltage source at the terminal position capable of inducing a change of impedance at the fault and time measuring means also at the terminal position. The method involves generating a first pulse at the terminal position which is propagated down the conductor and reflected back to the terminal position from various impedance discontinuities, including the impedance discontinuity of the fault, if present. The pattern of reflections from points along the conductor up to the fault resulting from the first pulse are recorded. Then sufficient voltage is applied to the cable to induce a change in impedance at the fault. Simultaneously a second pulse similar to the first is generated at the terminal position and reflected back from the various impedance discontinuities including the modified impedance discontinuity at the fault. The reflections of the first pulse are then subtracted from the reflections of the second pulse leaving the pulse reflected from the fault. The location of the fault is then determined from the time taken from initiation to reflection of the pulse to the terminal position.


5 Claims, 5 Drawing Sheets

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Courier New 12

DOCUMENT-IDENTIFIER: US 20020089335 A1

TITLE: Integrated time domain reflectometry (TDR) tester

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Detail Description Paragraph - DETX (57):

[0097] A person of ordinary skill in the art will readily appreciate that the above principles are applicable to single ended transmission lines as well as differential transmission lines. In accordance with the present invention, the TDR circuit operates on each wire of the differential transmission line individually. For example, if there are D+ and D- versions of a signal, two separate TDR receivers are needed, one for signal D+ and one for signal D-. The two separate TDR receivers operate independently. Although full differential-mode TDR is possible, operating on each wire individually allows independent measurements of the positive and the negative voltages. For example, by driving a positive step voltage STEP+ on the D+ wire and driving its inverse step voltage STEP- on the D- wire allows independent operation and measurement of the differential wires. In other words, the signals, controls, and readings of each TDR do not need to be executed simultaneously.

Details Text Image HTML KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
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| 6 | US 5408148 A | | USPAT | 19950418 | 16 | Sense |

Details Text Image HTML

US 20020089335A1

(19) United States
(12) Patent Application Publication (10) Pub. No.: US 2002/0089335 A1
Williams (43) Pub. Date: Jul. 11, 2002

(54) INTEGRATED TIME DOMAIN REFLECTOMETRY (TDR) TESTER

(76) Inventor: Emrys J. Williams, Palo Alto, CA (US)

Correspondence Address:
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901 San Antonio Road
M/S UPAL01-521
Palo Alto, CA 94303 (US)

(21) Appl. No.: 09/759,126

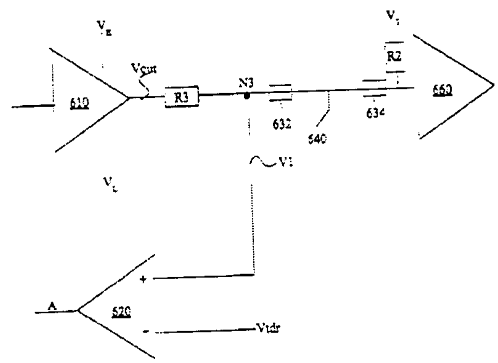
(22) Filed: Jan. 11, 2001

Publication Classification

(51) Int. Cl.7 ..................... G01R 31/11
(52) U.S. Cl. ..................... 324/533

(57) ABSTRACT

An integrated TDR for locating transmission line faults. An integrated circuit comprises a transmitter, a path coupled to the transmitter, and a TDR receiver integrated with the transmitter for analyzing a reflected signal from the path. The TDR receiver compares the reflected signal with a variable reference signal to generate a logic state at a sampling instant determined by a timebase generated by a sampling circuit. The reflected signal equals the variable reference signal when the logic state transitions. The reference signal and the corresponding timebase value are recorded at the logic state transition. A waveform is generated from the recorded reference signal and its corresponding timebase value. A reference point for the waveform is determined. The location of a fault on the transmission line can be determined from the timebase value difference between the reference point and the fault.

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EAST Browser - L9: (4) differential... | US 5479610 | Tag: S,P,T1 | Doc: 4/4 | "Full" 1/10 (Total images 10)

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Courier New 12

**DERWENT-ACC-NO:** 1995-185878

**DERWENT-WEEK:** 199735

*COPYRIGHT 1999 DERWENT INFORMATION LTD*

**TITLE:** System interface fault isolator test set for interfaces found in aircraft - uses time domain reflectometry test techniques to isolate faults from one end of cable

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**Basic Abstract Text - ABTX (2):**

VSWR data is obtained by processing the TDR data using software built into the maintenance control unit (2). The control unit is programmable to accommodate a variety of different system interfaces and bit status data can be downloaded directly to the control unit. Two adaptors (6) are also provided, one of which is connected to the control unit to analyse a multi-line digital bus, and the other one allows differential TDR measurements to be taken by the SI-FI on a MIL-STD-1553 bus.

Details Text Image HTML KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
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| 3 | JP 06282993 A | | JPO | 19941007 | 14 | PROGF |
| 4 | US 5479610 A | | DERWENT | 19950511 | 10 | Syste |

Details Text Image HTML

US005479610A

**United States Patent** [19]

**Roll-Mecak et al.**

[11] **Patent Number:** 5,479,610

[45] **Date of Patent:** Dec. 26, 1995

[54] SYSTEM INTERFACE FAULT ISOLATOR TEST SET

[75] Inventors: Doru T. Roll-Mecak, Long Beach; Stanley Teich, Melville, both of N.Y.

[73] Assignee: Northrop Grumman Corporation, Los Angeles, Calif.

[21] Appl. No.: 144,318

[22] Filed: Nov. 1, 1993

[51] Int. Cl.[6] ........ G01R 31/28

[52] U.S. Cl. ........ 395/183.01; 324/534

[58] Field of Search ........ 371/15.1, 22.4, 371/25.1, 27; 364/267.7; 324/527, 528, 533, 500, 512, 534; 395/575

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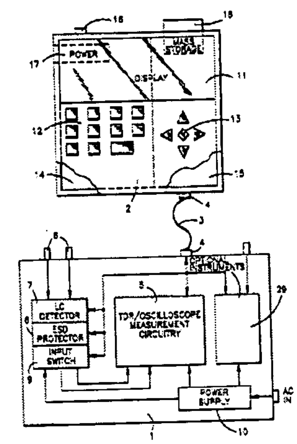
*Primary Examiner*—Robert W. Beausoliel, Jr.
*Assistant Examiner*—Albert Décady
*Attorney, Agent, or Firm*—Terry J. Anderson; Karl J. Hoch, Jr.


[57] **ABSTRACT**

A system interface fault isolator uses time domain reflectometry test techniques to isolate faults from only one end of a cable, a cable string or component without requiring removal of the cable or component from the system interface. A separate maintenance control unit includes a mass storage means for storing TDR or VSWR signatures of a variety of systems and comparing the signatures with data obtained by the TDR measurement board connected to the cable or component to be tested. VSWR data is obtained by processing the TDR data using software built-in the maintenance control unit. The control unit is programmable to accommodate a variety of different system interfaces, and bit status data can be downloaded directly to the control unit. Two adaptors are also provided, one of which is connected to the control unit to analyze a multi-line digital bus, and the other of which allows differential TDR measurements to be taken by the SI-FI on a MIL-STD-1553 bus.


**21 Claims, 5 Drawing Sheets**

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File Edit View Tools Window Help

DOCUMENT-IDENTIFIER: US 5471148 A
TITLE: Probe card changer system and method

BSPR:
According to the present invention, an improved wafer testing method and prober-to-test head interface system is provided. The system, also referred to hereinafter as the "autoloader" provides for convenient loading and changing of probe cards, as well as a more effective means for positioning probe cards during test operations. The present invention is also directed to a systematic method and device for probe card dam collection.

CCOR:
324/754

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
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Details Text Image

Sinsheimer et al. [45] Date of Patent: Nov. 28, 1995

[54] PROBE CARD CHANGER SYSTEM AND METHOD

[75] Inventors: Roger Sinsheimer, Petaluma; James Anderson, Santa Rosa, both of Calif.

[73] Assignee: Xandex, Inc., Petaluma, Calif.

[21] Appl. No.: 188,636

[22] Filed: Jan. 28, 1994

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 82,403, Jun. 24, 1993, abandoned.

[51] Int. Cl.$^6$ .......... G01R 31/02
[52] U.S. Cl. .......... 324/754; 439/331
[58] Field of Search .......... 439/331, 333; 324/754, 758

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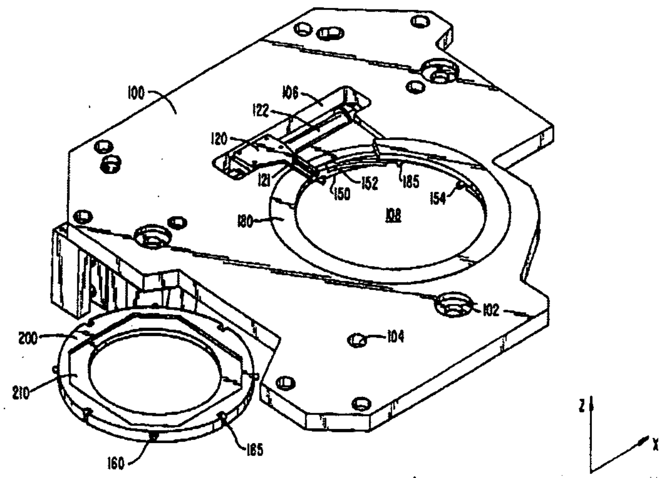
U.S. Ser. No. 08/082,403 filed Jun. 24, 1993.

*Primary Examiner*—Kenneth A. Wieder
*Assistant Examiner*—Mark Wardas
*Attorney, Agent, or Firm*—Townsend and Townsend and Crew

[57] ABSTRACT

A prober tester interface system is described which includes a carriage having a plurality of cam followers on its perimeter and a cam ring having a plurality of cam grooves on its interior. Positioning means are detachably coupled to the carriage for positioning the cam followers in the cam grooves. Rotating means are coupled to the cam ring for rotating the cam ring, thereby causing the cam followers to track in the cam grooves and move the carriage in a direction substantially perpendicular to the plane of the cam ring. A method is also described in which a carriage having a probe card disposed therein and a plurality of cam followers on its perimeter is positioned in a cam ring having a plurality of cam grooves located on its interior to engage the cam followers in the cam grooves. The probe card is equipped with a plurality of test pins. The cam ring is then rotated, thereby causing the cam followers to track in the cam grooves and move the carriage in a direction perpendicular to the plane of the cam ring, thereby coupling the prober card to a test head. A semiconductor wafer is then brought into contact with the test pins and probed.

21 Claims, 13 Drawing Sheets

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Courier New 12

DOCUMENT-IDENTIFIER: US 4943767 A
TITLE: Automatic wafer position aligning method for wafer prober

BSPR:
Each of the above-mentioned probers allow automatic changing of probe cards;
however, a fully automated semiconductor manufacturing system cannot be
achieved unless the probe aligning operation is automated along with the
automatic changing of probe cards.

BSPR:
It is an object of the present invention to provide a wafer prober which can
realize both automatic changing of probe cards and automated probe alignment of
a probe card, in correspondence with a change in the sort of wafer to be
measured.

CCOR:
324/758

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 39 | US 4943767 A | | USPAT | 19900724 | 11 | Aut |
| 40 | US 4797610 A | | USPAT | 19890110 | 10 | Ele |
| 41 | US 4764723 A | | USPAT | 19880816 | 13 | Waf |
| 42 | US 4758791 A | | USPAT | 19880719 | 9 | Uni |
| 43 | US 4701696 A | | USPAT | 19871020 | 10 | Ret |
| 44 | US 4697143 A | | USPAT | 19870929 | 10 | Waf |
| 45 | US 4647849 A | | USPAT | 19870303 | 6 | Two |

**United States Patent** [19]
**Yokota**

[11] **Patent Number: 4,943,767**
[45] **Date of Patent: Jul. 24, 1990**

[54] AUTOMATIC WAFER POSITION ALIGNING METHOD FOR WAFER PROBER

[75] Inventor: Keiichi Yokota, Nirasaki, Japan

[73] Assignee: Tokyo Electron Limited, Tokyo, Japan

[21] Appl. No.: 316,142

[22] Filed: Feb. 27, 1989

[30] Foreign Application Priority Data

Aug. 21, 1986 [JP] Japan ........ 61-193967

[51] Int. Cl.[5] ........ G01R 31/02; H04N 7/18
[52] U.S. Cl. ........ 324/158 F; 324/158 P; 358/101
[58] Field of Search ........ 324/158 F, 158 P, 73 PC; 358/101

[56] References Cited

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4,677,474 6/1987 Sato et al. ........ 358/101

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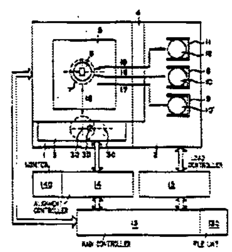
58-169922 10/1983 Japan .
59-44841 3/1984 Japan .
60-24029 2/1985 Japan .
62-16018 1/1987 Japan .

*Primary Examiner*—Ernest F. Karlsen
*Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt

[57] ABSTRACT

An automatic alignment method of the position of the probe tips and electric pads of wafer comprises the steps of recognizing and filing the position data of the pads of a new sort wafer and correction amount data between the position of the electrode pads and the probe tips equipped actually with the probe, determining and filing not less than 2 positions of electrode pads for an $\theta$ alignment of probe, detecting and outputting a height level data of a position of a dummy wafer, forming probe mark, detecting and outputting the positions, in X-, Y-axes, and $\theta$ direction offset between pads and tips, correcting these offset, repeated these check steps, saving final correction data, and using these data for aligning an actual wafer.

5 Claims, 6 Drawing Sheets



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Courier New 12

DOCUMENT-IDENTIFIER: US 4797610 A
TITLE: Electronic test fixture

BSPR:
Accordingly the invention overcomes some of the disadvantage cited by providing a structure which permits a circuit board to be placed directly in the fixture between two vertically positioned probe plates whereupon it is automatically aligned. The invention further permits the changing of probe plates in a convenient manner and use of a structure that ensures more precise alignment of the probe plate without placing exacting demands on machining of certain components of the fixture.

CCOR:
324/754

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 40 | US 4797610 A | | USPAT | 19890110 | 10 | Ele |
| 41 | US 4764723 A | | USPAT | 19880816 | 13 | Waf |
| 42 | US 4758791 A | | USPAT | 19880719 | 9 | Uni |
| 43 | US 4701696 A | | USPAT | 19871020 | 10 | Ret |
| 44 | US 4697143 A | | USPAT | 19870929 | 10 | Waf |
| 45 | US 4647849 A | | USPAT | 19870303 | 6 | Two |
| 46 | US 4636730 A | | USPAT | 19870113 | 10 | NMR |

**United States Patent** [19] — Fombellida

[11] Patent Number: 4,797,610
[45] Date of Patent: Jan. 10, 1989

[54] ELECTRONIC TEST FIXTURE

[76] Inventor: Miguel Fombellida, 905-371 Gilmour St., Ottawa, Canada, K2P 0R1

[21] Appl. No.: 860,891

[22] Filed: May 8, 1986

[51] Int. Cl.⁴ .................. G01R 31/02; G01R 31/28
[52] U.S. Cl. .................. 324/158 F; 324/73 PC; 324/158 P
[58] Field of Search .......... 324/158 F, 158 P, 73 PC, 324/72.5

[56] References Cited

U.S. PATENT DOCUMENTS

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|---|---|---|---|
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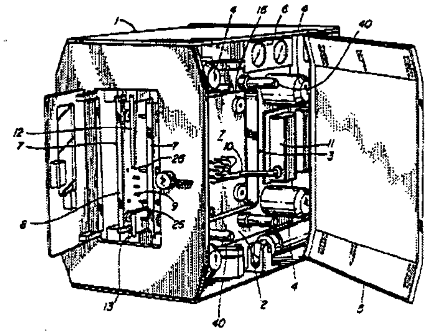
| 4,099,120 | 7/1978 | Aksu | 324/158 P |

Primary Examiner—Ernest F. Karlsen

[57] ABSTRACT

A fixture for testing circuit boards is provided with index pins that lift the circuit board into position for testing by contact probes. The index pins and contact probes may be mounted in a separately demountable cassette. The use of the cassette system allows relaxation of manufacturing tolerance demands.

16 Claims, 4 Drawing Sheets



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Courier New 12

DOCUMENT-IDENTIFIER: US 4510691 A
TITLE: Device for measuring distances between two opposite surfaces

DEPR:
The ferrule 3, the probe 4 and the rod 5 constitute together a probe assembly.
By changing this probe assembly, measuring organs with different diameters and forms of the feeler head 4a can be inserted in lever 6. The rod 5 is provided with abutment means, such as stop surface 5a, cooperating with the stop 12. If the position of this stop surface 5a of the rod 5 is chosen in function of the diameter of the feeler head 4a, the angular movement of lever 6 can be controlled in such a way that the clearance between the pin 11 and the eccentric part 11a always remains the same so that different probe assemblies can be secured to lever 6 without changing the position of the stops in the body 1.

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 4510691 A | | USPAT | 19850416 | 3 | Devic |

# United States Patent [19]

Meyer

[11] Patent Number: 4,510,691

[45] Date of Patent: Apr. 16, 1985

[54] DEVICE FOR MEASURING DISTANCES BETWEEN TWO OPPOSITE SURFACES

[76] Inventor: Hans Meyer, Rue du Bugnon 24, 1020 Renens, Switzerland

[21] Appl. No.: 538,518

[22] Filed: Oct. 3, 1983

[30] Foreign Application Priority Data

Oct. 8, 1982 [CH] Switzerland .................... 5939/82

[51] Int. Cl.[3] .................... G01B 5/02
[52] U.S. Cl. .................... 33/169 R; 33/DIG. 8
[58] Field of Search .......... 33/125 R, 164 D, 169 R, 33/172 B, 172 E, DIG. 8

[56] References Cited

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3,113,385 12/1963 Carter .................... 33/169 R
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3,520,063 7/1970 Rethwish et al. .................... 33/169 R
3,812,590 5/1974 Nigg et al. .................... 33/DIG. 8

FOREIGN PATENT DOCUMENTS

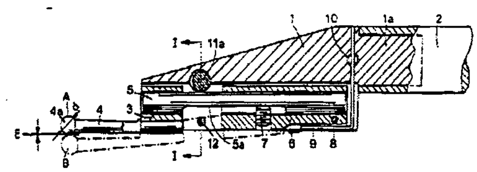
2011346 9/1970 Fed. Rep. of Germany ... 33/169 R

Primary Examiner—Richard R. Stearns
Attorney, Agent, or Firm—Emory L. Groff, Jr.

[57] ABSTRACT

The measuring device comprises a body (1) whose end (1a) is secured to a rod (2) connected to a measuring instrument. A probe assembly (3,4,5) is provided with a feeler head (4a) and is secured to a lever (6) which rotates around a pin (8) in the body (1). The angular path of the lever (6) is limited by a stop (12) built into the body (1) and by a stop adjustable by means of an eccentric part (11a) in such a manner that the body (1) always takes the same position in each measuring direction on alternate measuring of two opposite surfaces lying in the same plane. A spring (9) urges the lever (6) towards its upper position. By this means, the measurement of the distance between opposite surfaces requires no calculation, i.e. addition or subtraction of measuring constants, thus making measurement easier and precluding errors in calculations.

6 Claims, 2 Drawing Figures

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Courier New 12

TITLE: Probe system for device and circuit testing

BSPR:
In the prior art, such probe systems have typically used
probes, which are
normally in the form of very fine needles, that are
individually attached to a
printed circuit card by either soldering the probe directly
to the printed
circuit board or to a holding device which in turn is
soldered to the printed
circuit card. It has been suggested in the prior art that a
blade such as the
type described in U.S. Pat. No. 4,161,692 be secured to a
printed circuit
card with needles or probes attached to the end of the blade.
The probes
typically extend from the mounting place such as the blade in
a cantilever arm
fashion reaching out as much as several hundred mils to the
point on the
circuit, the pad, to be probed. To change the force on the
probe requires
either changing the probe diameter to make the probe stiffer
or more flexible,
or changing the probe length or cantilever length. Further,
the utilization of
such probes does not provide a convenient means for
implementing a controlled
impedance transmission line; that is, in many high frequency
test environments,
the use of transmission line techniques is very important for
the accuracy and
validity of the test.

CCOR:
324/758

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 36 | US 5066907 A | | USPAT | 19911119 | 9 | Pro |
| 37 | US 5059904 A | | USPAT | 19911022 | 10 | Con |
| 38 | US 5028866 A | | USPAT | 19910702 | 7 | Metl |
| 39 | US 4943767 A | | USPAT | 19900724 | 11 | Aut |
| 40 | US 4797610 A | | USPAT | 19890110 | 10 | Ele |
| 41 | US 4764723 A | | USPAT | 19880816 | 13 | Waf |
| 42 | US 4758791 A | | USPAT | 19880719 | 9 | Uni |

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# United States Patent [19]

Tarzwell et al.

[11] Patent Number: 5,066,907

[45] Date of Patent: Nov. 19, 1991

[54] PROBE SYSTEM FOR DEVICE AND CIRCUIT TESTING

[75] Inventors: John W. Tarzwell, Scottsdale; Patrick J. Tarzwell, Mesa; Theodore R. Myers, Tempe; Barry M. Hyland, Scottsdale; John C. Dahl, Mesa; Jack L. Eddings, Scottsdale, all of Ariz.

[73] Assignee: Cerprobe Corporation, Tempe, Ariz.

[21] Appl. No.: 475,820

[22] Filed: Feb. 6, 1990

[51] Int. Cl.5 ........ G01R 1/06; G01R 31/02

[52] U.S. Cl. ........ 324/158 P; 324/72.5; 324/158 F

[58] Field of Search ........ 324/158 P, 158 F, 72.5, 324/73.1

[56] References Cited

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| 4,847,553 | 7/1989 | Seinecke | 324/158 |

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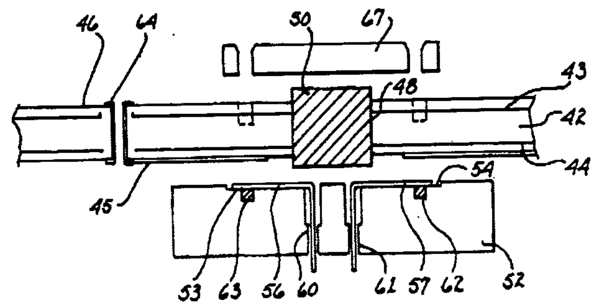
IBM Technical Disclosure Bulletin, vol. 14, No. 2, Jul. 1971, p. 568.

*Primary Examiner*—Ernest F. Karlsen
*Attorney, Agent, or Firm*—Cahill, Sutton & Thomas

[57] ABSTRACT

A probe assembly is described for providing temporary connection to electrical circuits under test such as integrated circuits and the like. Individual probes are formed of suitable metal and are provided with a 90° bend to create a depending portion for contact with a pad of a circuit under test and to form a supported length extending along a slot formed in the surface of a probe guide. The slot in the probe guide terminates at a hole for receiving the depending portion of the probe; the probe is supported by and positioned by the probe guide within the slot and hole provided therefore; an elastomeric pad is placed over a portion of the probe in the slot and a pressure plate urges the elastomer into contact with the probe to provide biasing force to urge the probe to extend through the probe guide hole into contact with the pad of the circuit under test. The pressure plate may contain signal traces for connection to the supported length of the probe to permit signals to be communicated from the probe tip in contact with the pad to a location remote from the probe.

7 Claims, 3 Drawing Sheets

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Courier New 12

DOCUMENT-IDENTIFIER: US 5793219 A
TITLE: Testing of semiconductor integrated circuits

BSPR:
In another preferred embodiment of the invention, the method comprises the steps of a) sequentially conducting a test of each of a given number of the integrated circuit chips and calculating a fraction defective over the given number of the integrated circuit chips as a result of the test, b) changing probe pressure with which the probe styli contact the electrodes on the integrated circuit chips, to a different value from a value applied in the test conducted in the step a) whenever the calculated fraction defective exceeds a predetermined value, c) conducting a test of the given number of the integrated circuit chips at the different value of probe pressure whenever the probe pressure is changed to the values, d) calculating the fraction defective over the given number of the integrated circuit chips as a result of the test conducted at the different value of probe pressure, and e) selecting a value of probe pressure which exhibited a minimum value of fraction defective as the detraction defective calculated at the step d), from among a plurality of different values of probe pressure applied in the test conducted in the step c).

BSPR:

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| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 19 | US 5793219 A | | USPAT | 19980811 | 18 | Tes |
| 20 | US 5716878 A | | USPAT | 19980210 | 9 | Ret |
| 21 | US 5691648 A | | USPAT | 19971125 | 21 | Met |
| 22 | US 5675499 A | | USPAT | 19971007 | 35 | Opt |
| 23 | US 5675249 A | | USPAT | 19971007 | 7 | Por |
| 24 | US 5596280 A | | USPAT | 19970121 | 10 | App |
| 25 | US 5530372 A | | USPAT | 19960625 | 35 | Met |

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Iida

[45] Date of Patent: Aug. 11, 1998

[54] TESTING OF SEMICONDUCTOR INTEGRATED CIRCUITS

[75] Inventor: Shunichi Iida, Hamamatsu, Japan

[73] Assignee: Yamaha Corporation, Hamamatsu, Japan

[21] Appl. No.: 691,173

[22] Filed: Aug. 1, 1996

[30] Foreign Application Priority Data

Aug. 2, 1995 [JP] Japan .................... 7-197810

[51] Int. Cl.[6] .................... G01R 31/02

[52] U.S. Cl. .................... 324/757

[58] Field of Search .................... 324/758, 72.5, 324/757, 754–769; 438/14–18

[56] References Cited

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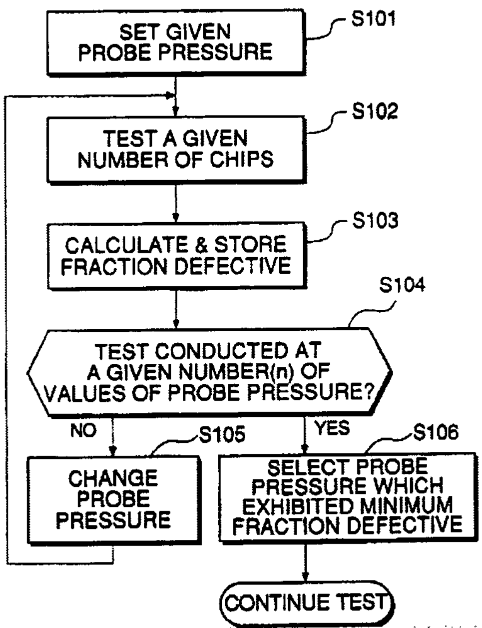
4,994,735 2/1991 Leedy .................... 324/755

*Primary Examiner*—Ernest F. Karlsen
*Assistant Examiner*—Anh Phung
*Attorney, Agent, or Firm*—Pillsbury Madison & Sutro LLP

[57] ABSTRACT

A semiconductor integrated circuit is tested such that probe styli are brought into contact with electrodes on integrated circuit chips formed in a semiconductor wafer to test circuit characteristics of the integrated circuit chips. A test is conducted over a given number of integrated circuit chips. A fraction defective over the given number of integrated circuit chips is calculated as a result of the test conducted. Probe pressure with which the probe styli contact the electrodes on the integrated circuit chips is controlled on the basis of the calculated fraction defective.

5 Claims, 10 Drawing Sheets

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both random noise as well as undesired responses that are not random.

During manufacturing, the dielectric 205 is deposited on the capacitive plate 202 and then the guard plate 204 is deposited on the dielectric. Next, the guard plate is etched down to the dielectric 205 to form traces for a buffer circuit 208 and a groove 316 is etched all the way around the buffer circuit area to electrically isolate the buffer circuit from the guard plate. During manufacturing, the buffer circuit 208 is mounted to the traces formed from the guard plate by using a chip on board procedure. The buffer circuit is electrically connected by a pin in socket connector 218 to a standard signal electrode spring pin 212, which acts as an electrical coupling means to a measuring device. The guard plate 204 is electrically connected via connector 220 to a guard electrode spring pin 210, which electrically couples the guard plate to system ground or a controlled voltage source.

Spring pins 210 and 212 can be standard off-the-shelf spring pins, such as a 100PR4070 made by QA Technology Company of Hampton, New Hampshire. Spring pins 210 and 212 give the test probe z axis travel, which allows for intimate coupling with the integrated circuit component to be tested, regardless of the height of the component. Also, when the invention is used to test an entire circuit board, as in FIG. 1, the z axis travel of the spring

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**U.S. Patent** Mar. 12, 1996 Sheet 2 of 12 5,498,964

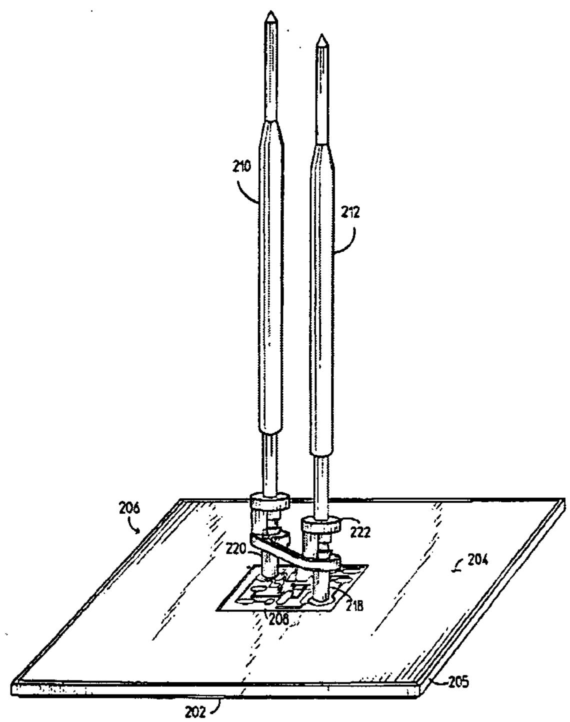


FIG 2

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DRPR:
FIG. 2 is a schematic indicating the cable of FIG. 1 having a probe attached to it and connected to an open signal launch for the performance of the first and third calibration steps according to the invention.

DRPR:
FIG. 4 is a schematic indicating the cable of FIG. 1 having a referee impedance standard attached to it and terminated by another cable for the performance of the second calibration step according to the invention.

DEPR:
The amplitude of the step that is incident on the line under test 18 is not the same as the amplitude of the step emerging from the instruments port 26. A series of calibration steps compensates for this difference in amplitude. The calibration steps are used to determine V.sub.incident, V.sub.reference, and T.sub.reference.sbsb.--.sub.point. The calibration steps may be performed in any order. Good results have been obtained by using the following sequence of steps.

DEPR:
The first calibration step is performed to determine T.sub.reference.sbsb.--.sub.point. As shown in FIG. 2, this step involves connecting the probe 14 to a signal launch 31 that is on the PWB 28. The signal launch 31 could be a via on a PWB. The signal launch 31 selected for this step must be structurally the same as the signal launch

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| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 6024526 A | | USPAT | 20000215 | 25 | Intec |
| 2 | US 5498965 A | | USPAT | 19960312 | 15 | Drivi |

US005498965A

# United States Patent [19]

Mellitz

[11] Patent Number: 5,498,965

[45] Date of Patent: Mar. 12, 1996

[54] DRIVING POINT REFERENCE PLANE TIME DOMAIN REFLECTOMETRY METHOD FOR MEASURING CHARACTERISTIC IMPEDANCE


[75] Inventor: Richard I. Mellitz, Pepperell, Mass.

[73] Assignee: Digital Equipment Corporation, Maynard, Mass.



[21] Appl. No.: 167,381

[22] Filed: Dec. 15, 1993

[51] Int. Cl.$^6$ .......... G01R 31/08

[52] U.S. Cl. .......... 324/532

[58] Field of Search .......... 324/532, 535, 324/522, 543, 544, 539, 541, 551


[56] References Cited

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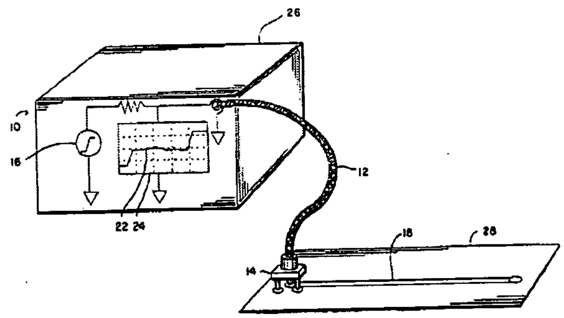
Application Note 62: TDR Fundamentals, For Use With HP 54120T Digitizing Oscilloscope and TDR, Hewlett Packard, Apr. 1988.

*Primary Examiner*—Maura K. Regan
*Attorney, Agent, or Firm*—Krishnendu Gupta; Ronald C. Hudgens; Arthur W. Fisher


[57] ABSTRACT

Method for determining the characteristic impedance of a transmission line on a printed wiring board using time domain reflectometry. The method involves selecting a driving point in time, selecting an undisturbed interval, measuring voltage at predetermined time intervals across the undisturbed interval, determining from the measured voltages a curve representative of such voltages, and determining the voltage on the representative curve at the driving point. The characteristic impedance of the transmission line under test, denoted by $Z_0$, is obtained by using the "driving point" of the transmission line as the reference plane for the impedance measurements.


13 Claims, 9 Drawing Sheets

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DOCUMENT-IDENTIFIER: US 5631856 A
TITLE: Test sequence optimization process for a circuit tester

DWKU:
5631856

DEPR:
A variable named "Pitch " is developed to indicate the shortest weighted distance between sets of points and next move candidates as determined by the process described above. This variable is used, in a manner which will be described, in the Second Pass of the Optimization Algorithm to determine which sets of points are of interest for consideration as the next set of points to be linked with a given set of points. Since "Pitch " is set according to the minimum move distance, the "Pitch " value is saved the first time the "CurrentMax" variable is calculated, to begin the process of determining a "Pitch " value, and otherwise whenever the value of "CurrentMax" is less that the value of "Pitch ". Thus, determinations are made in steps 98 and 100 of whether "CurrentMax" has been calculated for the first time, and whether "CurrentMax" is less than the value currently stored for "Pitch ". If either of these is true, "Pitch " is set equal to "CurrentMax" in step 102.

DEPR:



| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 6024526 A | | USPAT | 20000215 | 25 | Integ |
| 2 | US 5781021 A | | USPAT | 19980714 | 18 | Unive |
| 3 | US 5631856 A | | USPAT | 19970520 | 24 | Test |
| 4 | US 5498964 A | | USPAT | 19960312 | 19 | Capac |
| 5 | US 5469064 A | | USPAT | 19951121 | 19 | Elect |



US005631856A

# United States Patent [19]

Keller et al.

[11] Patent Number: 5,631,856
[45] Date of Patent: May 20, 1997

[54] TEST SEQUENCE OPTIMIZATION PROCESS FOR A CIRCUIT TESTER

[75] Inventors: Steven A. Keller, Coral Springs; Jiann-Chang Lo, Boca Raton; James C. Mahlbacher, Lake Worth, all of Fla.

[73] Assignee: International Business Machines Corporation, Armonk, N.Y.

[21] Appl. No.: 373,338
[22] Filed: Jan. 17, 1995
[51] Int. Cl.[6] .......... G01R 15/12
[52] U.S. Cl. .......... 364/578; 324/758
[58] Field of Search .......... 364/578, 488, 364/489, 490, 491, 474.37, 468.28; 324/754, 758, 761, 762, 158.1, 73.1, 519, 537

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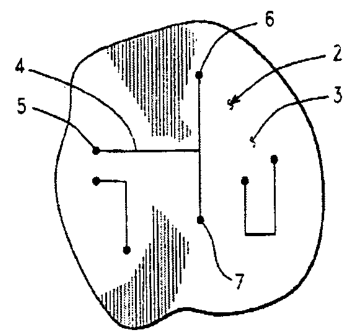
| 5,485,081 | 1/1996 | Whitehead et al. | 324/158.1 |
| 5,550,483 | 8/1996 | Boyette, Jr. et al. | 324/758 |


*Primary Examiner*—Kevin J. Teska
*Assistant Examiner*—Matthew Loppnow
*Attorney, Agent, or Firm*—Richard A. Tomlin; Ronald V. Davidge

[57] ABSTRACT

The sequential order of movements of a number of probes within a circuit test fixture is optimized through the use of an algorithm which sequentially orders test configurations provided in an input list. Each test configuration corresponds to the locations of probes within the fixture as a particular test is performed. In a first pass of the algorithm, for each test configuration, every other test configuration is considered as a next move candidate for which a weighted distance is calculated from the test configuration. Weighting factors reflect the degree of difficulty in moving one direction instead of another. A need to move one probe before another or to move in one direction before another, in order to prevent a collision within the test fixture, is also considered. A predetermined number of next move candidates having the lowest weighted distances are placed in an intermediate list for the test configuration. In a second pass of the algorithm, test configurations are linked, one to another, to form a list reflecting a preferred order of probe movement. In the process of linking with a test configuration, the available next move candidate having the shortest weighted distance is chosen from the intermediate list of the test configuration. If no available next move candidates remain in the intermediate list, the process returns to the first pass of the algorithm to get more next move candidates. Additionally, the algorithm is used to sequentially order individual points for a test fixture having only a single probe.

24 Claims, 9 Drawing Sheets



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the test area, for contacting conductive elements of said
workpiece, regardless
of pitch  and configurations of the conductive elements of
the workpiece, the
test area comprising:

CLPR:
6.  The test equipment of claim 1, wherein density and pitch
of test electrodes
at surface facing the workpiece is scaled such as to provide
a continuous
uniform mattress of test electrodes through design of new
adapter/pitch
translator's, thereby providing for universal usage in
accordance with
technological advancements needs.

CLPR:
10.  The test equipment as in claim 1, further comprising a
second congruent
test area, substantially parallel to the test area, the test
equipment for
simultaneous functionality testing of both surfaces of a
workpiece placed in an
arbitrary position and orientation with respect to the test
area and said
second test area, for contacting the conductive elements of
the workpiece,
regardless of pitch  and configurations of the conductive
elements of the
workpiece.

CLPV:
said cushion having bumps on said second surface facing the
workpiece, said
bumps having density and pitch  corresponding to density and
pitch  of said
second cross section surface of adapter/pitch translator
facing said cushion.
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Details | Text | Image | KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 6024526 A | | USPAT | 20000215 | 25 | Integ |
| 2 | US 5781021 A | | USPAT | 19980714 | 18 | Unive |
| 3 | US 5631856 A | | USPAT | 19970520 | 24 | Test |
| 4 | US 5498964 A | | USPAT | 19960312 | 19 | Capac |
| 5 | US 5469064 A | | USPAT | 19951121 | 19 | Elect |

US005781021A

# United States Patent [19]

Ilani

[11] Patent Number: 5,781,021

[45] Date of Patent: Jul. 14, 1998

[54] UNIVERSAL FIXTURELESS TEST EQUIPMENT


[75] Inventor: Avner Ilani, Kiron, Israel

[73] Assignee: Key Solutions Ltd., Kiron, Israel



[21] Appl. No.: 740,514

[22] Filed: Oct. 30, 1996

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 370,067, Jan. 9, 1995, Pat. No. 5,633,996.

[30] Foreign Application Priority Data

Jan. 11, 1994 [IL] Israel ........ 107550/2
Jan. 11, 1994 [IL] Israel ........ 107550/3
Aug. 24, 1994 [IL] Israel ........ 107550/4

[51] Int. Cl.[6] ........ G01R 31/02
[52] U.S. Cl. ........ 324/754; 324/765
[58] Field of Search ........ 324/754, 765, 324/755, 758, 761



[56] References Cited

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| 4,966,520 | 10/1990 | Yokota et al. | 414/786 |
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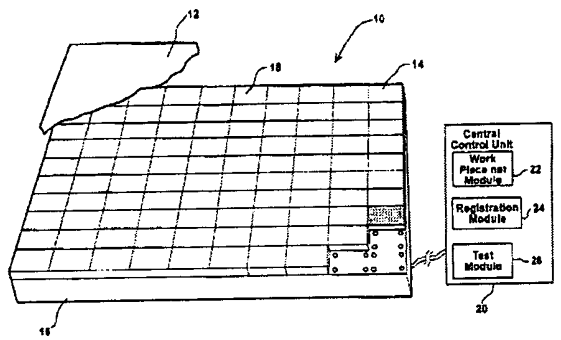
| 5,055,780 | 10/1991 | Takagi et al. | 324/754 |
| 5,070,297 | 12/1991 | Kwon et al. | 324/754 |
| 5,198,757 | 3/1993 | Aizumi | 324/754 |
| 5,363,038 | 11/1994 | Love | 324/158.1 |
| 5,497,079 | 3/1996 | Yamada et al. | 324/158.1 |
| 5,506,510 | 4/1996 | Blumenau | 324/754 |
| 5,532,610 | 7/1996 | Tsujide et al. | 324/754 |


Primary Examiner—Ernest F. Karlsen
Assistant Examiner—Anh Phung
Attorney, Agent, or Firm—Mark M. Friedman

[57] ABSTRACT


A universal, fixtureless automatic test equipment is provided, capable of accessing opposite surfaces of any workpiece, simultaneously, for functionality testing. The workpiece can be freely placed anywhere on the test area, regardless of orientation, without the need for pre-test registration, alignment, or any kind of securing means. The test area of a universal fixtureless automatic test equipment, according to the teachings of the present invention, is made up of Independent Test Modules (ITMs). A test area may be configured from any number of ITMs, as desired. The ITMs can be individually selected for testing various functions of a respective section of a workpiece under test, and for independent electrical functioning. A typical ITM is made up of a plurality of semiconductor dies. Dies are similarly structured with matrices of selectable memorized bidirectional switching cells. Each switching cell is connected to a terminal-pad on the surface of the die. The terminal-pads extend to a test mattress of highly dense, compressible microchip bumps by means of a Adapter/Pitch Translator. These bumps function as independent test electrodes and are dimensioned to provide two positive features: to guarantee that each tested element on a workpiece corresponds with at least two of the test electrodes, and that the test electrodes are dimensioned to prevent shortages between adjacent pairs of tested elements.


21 Claims, 7 Drawing Sheets

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DOCUMENT-IDENTIFIER: US 6024526 A
TITLE: Integrated prober, handler and tester for semiconductor components

DWKU:
6024526

DEPR:
Camera 5 is any known type of camera customarily used for optical inspection.
Its position relative to base 13 is preferably precisely defined, either by exact placement or by calibration . The position can be precisely defined through high accuracy manufacturing techniques. In a preferred embodiment, though, a calibration routine is run. During calibration, the camera 5 is focused on features of base 13 or positioning mechanism 11a or 11b. The image of these features is used to compute the relative position of positioning mechanism 11a and 11b and camera 5.

Details | Text | Image | KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 6024526 A | | USPAT | 20000215 | 25 | Integ |
| 2 | US 5498965 A | | USPAT | 19960312 | 15 | Drivi |

US006024526A

# United States Patent [19]

Slocum et al.

[11] Patent Number: 6,024,526

[45] Date of Patent: *Feb. 15, 2000

[54] INTEGRATED PROBER, HANDLER AND TESTER FOR SEMICONDUCTOR COMPONENTS

[75] Inventors: Alexander H. Slocum, Bow, N.H.; Luis A. Muller, Cambridge, Mass.

[73] Assignee: Aesop, Inc., Concord, N.H.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: 08/546,236

[22] Filed: Oct. 20, 1995

[51] Int. Cl.[7] ........ B25J 15/06

[52] U.S. Cl. ........ 414/226.01, 901/40

[58] Field of Search ........ 414/222, 225, 414/226, 403, 729, 736, 737, 222.01, 225.01, 226.01; 901/25, 29, 47, 8, 16, 40; 294/64.1, 65; 29/832, 833, 834, 740

[56] References Cited

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| 4,571,149 | 2/1986 | Scroka et al. | 414/750 |
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| 4,654,955 | 4/1987 | Mathie | 414/225 X |
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| 4,936,329 | 6/1990 | Michael et al. | 414/225 X |
| 5,052,736 | 10/1991 | Loncaric et al. | 294/106 |
| 5,114,300 | 5/1992 | Shahinpoor et al. | 901/29 X |
| 5,129,279 | 7/1992 | Rennex | 901/15 X |
| 5,131,535 | 7/1992 | O'Conner et al. | 206/329 |
| 5,161,936 | 11/1992 | Kato | 901/8 X |
| 5,168,218 | 12/1992 | Rich | 324/158 |
| 5,177,434 | 1/1993 | Suzuki et al. | 324/158 |
| 5,180,974 | 1/1993 | Mitchell et al. | 324/158 |
| 5,284,413 | 2/1994 | Wilkinson et al. | 294/65 X |
| 5,290,134 | 3/1994 | Baba | 414/404 |
| 5,307,011 | 4/1994 | Tani | 324/158 |
| 5,350,269 | 9/1994 | Azuma et al. | 901/47 X |
| 5,384,531 | 1/1995 | Yamazaki et al. | 324/765 |
| 5,451,134 | 9/1995 | Bryfogle | 414/680 |
| 5,544,421 | 8/1996 | Thompson | 414/222 |

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| 0 749 002 | 12/1996 | European Pat. Off. | G01D 5/241 |
| 2 543 186 | 9/1984 | France | E02B 3/14 |
| 41 17 538 | 7/1992 | Germany | G02B 23/16 |
| 63-56927 | 8/1988 | Japan | H01L 21/66 |
| 92/17313 | 10/1992 | WIPO | B23Q 1/14 |
| 94/29946 | 12/1994 | WIPO | H02N 2/10 |

OTHER PUBLICATIONS

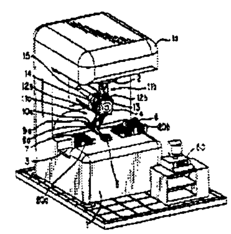
Tegal Advertisement, *Electronics News*, Sep. 25, 1995.
Geodetics Brochure, undated.

*Primary Examiner*—Donald W. Underwood
*Attorney, Agent, or Firm*—Edmund J. Walsh

[57] ABSTRACT

An integral unit for use in testing semiconductor components. The unit is designed to manipulate either packaged semiconductor components or semiconductor wafers and present them to a test head. It provides significant space savings because it replaces the need for separate prober, handler and tester units. The integrated unit includes a positioning mechanism with a tool plate that can be changed to grasp either a semiconductor wafer or a tray of semiconductor components. The tool plate uses a vacuum plate. To hold a tray of semiconductor parts, the vacuum plate has numerous independently operable holes. Each hole is positioned behind one semiconductor component and can be engaged or released separately so that the components can be sorted into separate output bins. To hold a wafer, the tool plate has an extendible tongue member that can be inserted into a stack of semiconductor wafers to pick up one wafer in the stack. One disclosed positioning mechanism is a hexapod unit, which, due to its light weight, allows fast and accurate positioning of the semiconductor devices. Multiple positioning mechanisms are used in some instances to increase throughput.

29 Claims, 15 Drawing Sheets



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DOCUMENT-IDENTIFIER: US 6024526 A
TITLE: Integrated prober, handler and tester for semiconductor components

DWKU:
6024526

BSPR:
Tray type handlers are less prone to jamming. However, to test multiple parts simultaneously, the components must be loaded into trays which hold the components with the same spacing (pitch ) as the test sites. Elements are sometimes included in the handler to load the trays into appropriate sized trays. After the test, the components must be unloaded into trays based on the results of the test. These loading and unloading operations are often performed with one or more "pick and place" units. A "pick and place" is a vacuum actuated device which can pick up a component, move it about in a plane and then set it down. These devices have three degrees of motion and generally a limited range of travel. They are therefore less complicated than a full robotic manipulator. Nonetheless, they reduce the speed of operation, increase the complexity of the handler and occupy space.

DEPR:
When the wafer or tray of chips is presented to the test head

Details Text Image KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 6024526 A | | USPAT | 20000215 | 25 | Integ |
| 2 | US 5781021 A | | USPAT | 19980714 | 18 | Unive |
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| 5 | US 5469064 A | | USPAT | 19951121 | 19 | Elect |

Details Text Image

US006024526A

**United States Patent** [19]
**Slocum et al.**

[11] **Patent Number: 6,024,526**
[45] **Date of Patent: *Feb. 15, 2000**

[54] INTEGRATED PROBER, HANDLER AND TESTER FOR SEMICONDUCTOR COMPONENTS

[75] Inventors: Alexander H. Slocum, Bow, N.H.; Luis A. Muller, Cambridge, Mass.

[73] Assignee: Aesop, Inc., Concord, N.H.

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[51] Int. Cl.[7] ........ B25J 15/06
[52] U.S. Cl. ........ 414/226.01; 901/40
[58] Field of Search ........ 414/222, 225, 414/226, 403, 729, 736, 737, 222.01, 225.01, 226.01; 901/28, 29, 47, 8, 16, 40; 294/64.1, 65; 29/832, 833, 834, 740

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| 4,654,955 | 4/1987 | Marble | 414/226 X |
| 4,675,993 | 6/1987 | Harada | 29/740 |
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| 5,307,011 | 4/1994 | Tani | 324/158 |
| 5,350,269 | 9/1994 | Azuma et al. | 901/45 X |
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| 5,451,134 | 9/1995 | Bryfogle | 414/680 |
| 5,544,421 | 8/1996 | Thompson | 414/222 |

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*Primary Examiner*—Donald W. Underwood
*Attorney, Agent, or Firm*—Edmund J. Walsh

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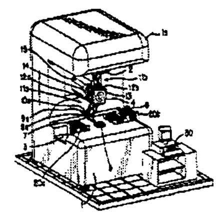
29 Claims, 15 Drawing Sheets



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testing the
functionality of a workpiece placed in an arbitrary position
and orientation on
the test area, for contacting conductive elements of said
workpiece, regardless
of pitch and configurations of the conductive elements of
the workpiece, the
test area comprising:

CLPR:
6. The test equipment of claim 1, wherein density and pitch
of test electrodes
at surface facing the workpiece is scaled such as to provide
a continuous
uniform mattress of test electrodes through design of new
adapter/pitch
translator's, thereby providing for universal usage in
accordance with
technological advancements needs.

CLPR:
10. The test equipment as in claim 1, further comprising a
second congruent
test area, substantially parallel to the test area, the test
equipment for
simultaneous functionality testing of both surfaces of a
workpiece placed in an
arbitrary position and orientation with respect to the test
area and said
second test area, for contacting the conductive elements of
the workpiece,
regardless of pitch and configurations of the conductive
elements of the
workpiece.

CLPV:
said cushion having bumps on said second surface facing the
workpiece, said

Details | Text | Image | KWIC

| | Document ID | Kind Codes | Source | Issue Date | Pages | |
|---|---|---|---|---|---|---|
| 1 | US 5781021 A | | USPAT | 19980714 | 18 | Unive |

US005781021A

# United States Patent [19]

Ilani

[11] Patent Number: 5,781,021

[45] Date of Patent: Jul. 14, 1998

[54] UNIVERSAL FIXTURELESS TEST EQUIPMENT

[75] Inventor: Avner Ilani, Kiron, Israel

[73] Assignee: Key Solutions Ltd., Kiron, Israel

[21] Appl. No.: 740,514

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Aug. 24, 1994 [IL] Israel ........ 107550/4

[51] Int. Cl.[6] ........ G01R 31/02
[52] U.S. Cl. ........ 324/754; 324/765
[58] Field of Search ........ 324/754, 765, 324/755, 758, 761

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4,966,520 10/1990 Yokota et al. ........ 414/786
5,012,780 5/1991 Littlebury ........ 324/754
5,055,780 10/1991 Takagi et al. ........ 324/754
5,070,297 12/1991 Kwon et al. ........ 324/754
5,198,757 3/1993 Aitemai ........ 324/754
5,363,038 11/1994 Love ........ 324/158.1
5,497,079 3/1996 Yamada et al. ........ 324/158.1
5,506,510 4/1996 Blumenau ........ 324/754
5,532,610 7/1996 Tsujide et al. ........ 324/754

Primary Examiner—Ernest F. Karlsen
Assistant Examiner—Anh Phung
Attorney, Agent, or Firm—Mark M. Friedman

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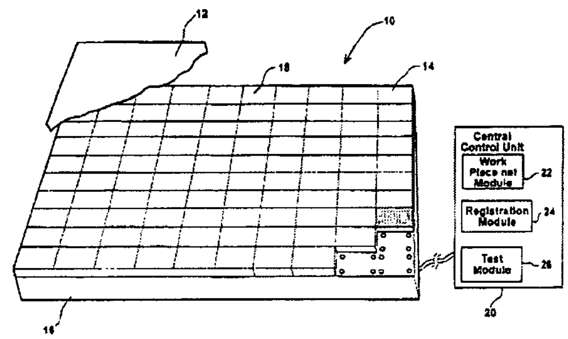
A universal, fixtureless automatic test equipment is provided, capable of accessing opposite surfaces of any workpiece, simultaneously, for functionality testing. The workpiece can be freely placed anywhere on the test area, regardless of orientation, without the need for pre-test registration, alignment, or any kind of securing means. The test area of a universal fixtureless automatic test equipment, according to the teachings of the present invention, is made up of Independent Test Modules (ITMs). A test area may be configured from any number of ITMs, as desired. The ITMs can be individually selected for testing various functions of a respective section of a workpiece under test, and for independent electrical functioning. A typical ITM is made up of a plurality of semiconductor dies. Dies are similarly structured with matrices of selectable memorized bidirectional switching cells. Each switching cell is connected to a terminal-pad on the surface of the die. The terminal-pads extend to a test mattress of highly dense, compressible micronic bumps by means of a Adapter/Pitch Translator. These bumps function as independent test electrodes and are dimensioned to provide two positive features: to guarantee that each tested element on a workpiece corresponds with at least two of the test electrodes, and that the test electrodes are dimensioned to prevent shortages between adjacent pairs of tested elements.

21 Claims, 7 Drawing Sheets

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fixtures utilizing non-contact test probes are just as complex and expensive as ohmic bed-of-nails fixtures. Accordingly, for fine pitch components, an alternative, less expensive approach to the non-contact test probe fixture is needed in which the secondary stimulus and associated test probes are moved precisely to the connection to be tested.

BSPR:
The present invention is a test system and method of testing electronic assemblies having fine pitch parts, double sided electronic assemblies and test fixtures.

CLPV:
a camera coupled to said robotic test probe positioning means, whereby said camera aligns said robotic test probe positioning means with said electronic assembly to compensate for misalignment, wherein said camera also provides vision for positioning of said at least one test probe over fine pitch elements on said second side of said electronic assembly, wherein said positioning of said at least one test probe is performed by said robotic test probe positioning means.

CLPV:
a camera coupled to said robotic test probe positioning means for aligning said robotic test probe positioning means with fiducials on said electronic assembly, said camera also provides vision for positioning of

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| 2 | US 5781021 A | | USPAT | 19980714 | 18 | Unive |
| 3 | US 5631856 A | | USPAT | 19970520 | 24 | Test |
| 4 | US 5498964 A | | USPAT | 19960312 | 19 | Capac |
| 5 | US 5469064 A | | USPAT | 19951121 | 19 | Elect |

U.S. Patent Nov. 21, 1995 Sheet 5 of 10 5,469,064

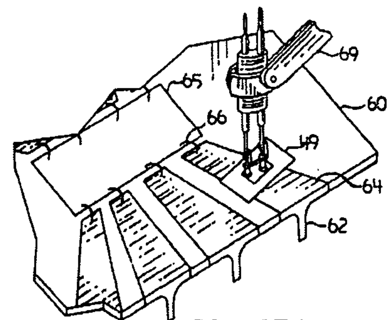

FIGURE 6

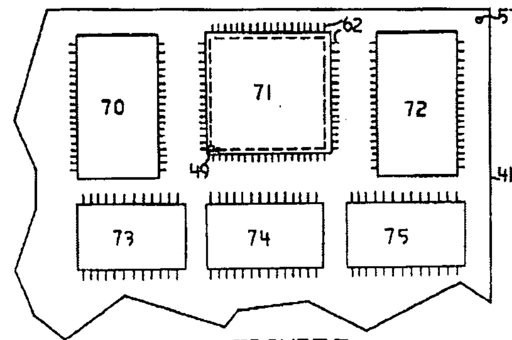

FIGURE 7

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Bypass capacitor 70 bypasses high frequency components to ground. The transformer provides an AC path for signals, while the resistor provides the proper DC termination. Capacitor 70 removes the effect of resistor 68 for AC path signals.

DEPR:
In accordance with the time-domain reflectometry instrument of the present invention, TDR pulses are sent out across the network. The typical pulse length is 125 nanoseconds. Such a pulse will propagate throughout the network but will not likely be recognized as a collision by transmitting stations on the network. However, even though the various transmitting stations will not recognize this collision, the pulse is capable of creating bit errors in the data transmitted by a particular station. Thus, as noted hereinabove, the bit errors will go undetected by the low-level transmission protocol and will require that the next level up or higher protocol determine that a data error has occurred. The difficulty with not detecting the bit error at the lower level protocol is that the higher level protocol may require 3 or 4 seconds or more before timing out or otherwise determining that an error has occurred. In performing the time-domain reflectometry, a large number of pulses are sent out in order to increase resolution and obtain accurate

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US005586054A

# United States Patent [19]

Jensen et al.

[11] Patent Number: 5,586,054

[45] Date of Patent: Dec. 17, 1996

[54] TIME-DOMAIN REFLECTOMETER FOR TESTING COAXIAL CABLES

[75] Inventors: Gordon A. Jensen; Stephen M. Ernst, both of Colorado Springs, Colo.

[73] Assignee: Fluke Corporation, Everett, Wash.

[21] Appl. No.: 272,690

[22] Filed: Jul. 8, 1994

[51] Int. Cl.[6] ........ G01R 31/11

[52] U.S. Cl. ........ 364/514 B; 370/235; 359/136; 324/534; 324/512

[58] Field of Search ........ 364/514 R, 514 B; 370/85.2, 85.3; 359/136; 324/534, 512

[56] References Cited

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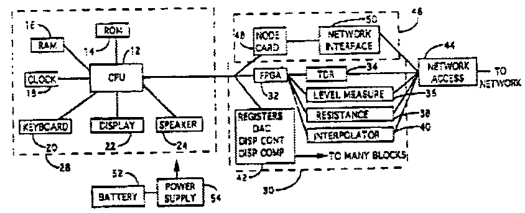
4,797,901 1/1989 Goerne et al. ........ 375/10
4,809,264 2/1989 Abraham et al. ........ 370/76
4,945,532 7/1990 Hald ........ 370/13
5,179,341 1/1993 Whiteside ........ 324/523
5,198,805 3/1993 Whiteside et al. ........ 340/825.06
5,381,348 1/1995 Ernst et al. ........ 364/514
5,390,039 2/1995 Yamamoto et al. ........ 359/136

Primary Examiner—Emanuel T. Voeltz
Assistant Examiner—Patrick J. Assouad
Attorney, Agent, or Firm—Dellett and Walters

[57] ABSTRACT

A time-domain reflectometry device and method are provided wherein TDR may be performed on active Ethernet systems. A crossover network provides proper impedance termination both for pulse information generated by the TDR and for DC path signals. If a potential collision is detected when generating TDR pulses, a collision is forced by asserting a DC bias on the network thereby simulating a collision and generating a timeout at a much lower protocol level for reducing noticeable delay to network users and increasing network throughput.

19 Claims, 8 Drawing Sheets

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requirements of the
particular network. Capacitor 70 provides a bypass for high frequency signals
to ground.

DEPR:
Referring now to FIG. 3, a schematic diagram of a particular driven crossover
network, this implementation will be described. The driven crossover network
comprises, as discussed herein-above, the transformer 64, the primary of which
is connected to a driver 62, and a detector 80 for providing TDR pulses and
detecting the same. The second leg of the primary of the transformer is
connected to ground. The secondary of the transformer is connected to the
connector 66 which suitably interfaces with the Ethernet. The second leg of
the transformer secondary is connected, as noted hereinbefore, to impedance 68
which is suitably a 50 OHM resistor in a particular application, to provide the
proper termination on the Ethernet, so as to not result in reflections or other
problems which would appear as a result of an improperly terminated node.
Bypass capacitor 70 bypasses high frequency components to ground. The
transformer provides an AC path for signals, while the resistor provides the
proper DC termination. Capacitor 70 removes the effect of resistor 68 for AC
path signals.

DEPR:

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US005586054A

# United States Patent [19]

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[54] TIME-DOMAIN REFLECTOMETER FOR TESTING COAXIAL CABLES

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[73] Assignee: Fluke Corporation, Everett, Wash.

[21] Appl. No.: 272,690

[22] Filed: Jul. 8, 1994

[51] Int. Cl.[6] ........ G01R 31/11

[52] U.S. Cl. ........ 364/514 B; 370/238; 359/136; 324/534; 324/512

[58] Field of Search ........ 364/514 R, 514 B; 370/85.2, 85.3; 359/136; 324/534, 512

[56] References Cited

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|---|---|---|---|
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| 4,809,264 | 2/1989 | Abraham et al. | 370/78 |
| 4,945,532 | 7/1990 | Hald | 370/13 |
| 5,179,341 | 1/1993 | Whiteside | 324/523 |
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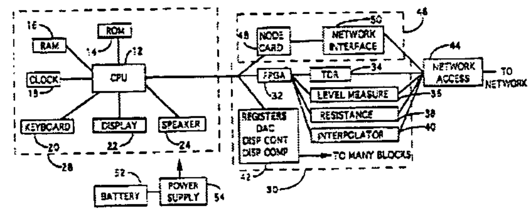
| 5,381,348 | 1/1995 | Ernst et al. | 364/514 |
| 5,390,039 | 2/1995 | Yamamoto et al. | 359/136 |

Primary Examiner—Emanuel T. Voeltz
Assistant Examiner—Patrick J. Assouad
Attorney, Agent, or Firm—Dellett and Walters

[57] ABSTRACT

A time-domain reflectometry device and method are provided wherein TDR may be performed on active Ethernet systems. A crossover network provides proper impedance termination both for pulse information generated by the TDR and for DC path signals. If a potential collision is detected when generating TDR pulses, a collision is forced by asserting a DC bias on the network thereby simulating a collision and generating a timeout at a much lower protocol level for reducing noticeable delay to network users and increasing network throughput.

19 Claims, 8 Drawing Sheets

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measurement. In
applications where the probe has a 50 ohm impedance process
connection,
matching that of the control electrical connection, the
design of the process
seal can cause an impedance mismatch.

DEPR:
The process instrument 10 includes a control housing assembly
12, a probe
assembly 14, and a connector 16 for connecting the probe
assembly 14 to the
housing assembly 12. The probe assembly 14 is typically
mounted to a process
vessel V using a threaded fitting 18. The control housing 12
and connector 16
may be as generally described in Mulrooney et al., U.S.
patent application
Ser. No. 09/094,142, filed Jun. 9, 1998, the specification
of which is hereby
incorporated by reference herein. Moreover, the circuitry
contained in the
housing 12 may be as generally described in Carsella et al.,
U.S. patent
application Ser. No. 09/336,194, filed Jun. 18, 1999, the
specification of
which is hereby incorporated by reference herein. As
described therein, a
probe comprises a high frequency transmission line which,
when placed in a
fluid, can be used to measure level of the fluid. Thus, the
probe assembly 14
is controlled by electronic circuitry in the housing assembly
12 for
determining level in the vessel V.

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| 1 | US 6247362 B1 | | USPAT | 20010619 | 7 | High |
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US 6,247,362 B1

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# HIGH TEMPERATURE HIGH PRESSURE PROBE SEAL

## FIELD OF THE INVENTION

This invention relates to process instruments and, more particularly, to a high temperature, high pressure seal for a probe assembly.

## BACKGROUND OF THE INVENTION

Various instruments have found use for applications requiring level sensing of, for example, a liquid or bulk material in a vessel. One such instrument comprises a time domain reflectometry measurement instrument. With any such instrument it is desirable to ensure safety of both equipment and personnel.

A time domain reflectometry measurement instrument uses guided wave radar for sensing level. The instrument includes a control housing and a probe. The probe is typically mounted to a process vessel using a threaded fitting or a flange fitting. The probe comprises a high frequency transmission line which, when placed in the vessel, is used to measure level of fluid in the vessel. The probe is controlled by electronics in the control housing for determining level in the vessel.

Process instruments are sometimes used for sensing level of a pressurized vessel. Often, the contents of the vessel is at a high temperature. In order to seal the vessel at the probe connection, an appropriate seal must be included. The seal must be appropriate for the relatively high temperatures and pressures when used in such applications.

A time domain reflectometry instrument, as well as certain other process instruments, imparts a pulse signal on the probe and receives a return signal. The relationship between the pulse signal and the return signal is used to determine level. Typically, the control housing includes a 50 ohm control connection for the probe. If the probe has a different impedance, then a mismatch results. The mismatch can cause errors in level measurement. In applications where the probe has a 50 ohm impedance process connection, matching that of the control electrical connection, the design of the process seal can cause an impedance mismatch.

The present invention is intended to satisfy one or more of the problems discussed above.

## SUMMARY OF THE INVENTION

In accordance with the invention, a process instrument includes a high temperature, high pressure probe seal.

Broadly, there is disclosed herein a high temperature, high pressure process seal for use with a process instrument having a control housing assembly with a control connection having a 50 ohm impedance, and a sensing element extending into a high temperature, high pressure process vessel. The sensing element has a process connection having a 50 ohm impedance. The seal operatively connects the sensing element to the control housing assembly. The seal includes an elongate cylindrical hollow seal adaptor receivable in an opening of the process vessel. An elongate shaft is coaxial with and extends through the adaptor and is adapted to connect the control connection to the process connection. A hard seal material between a select portion of the shaft and the adaptor is bonded to the shaft and the adaptor. Radial spacing between the shaft and the adaptor is greater at the select portion to provide a 50 ohm feed-through from the control connection to the process connection.

It is a feature of the invention that the shaft has a reduced diameter at the select portion. The adaptor has an inner cylindrical wall with an increased inner diameter at the select portion.

2

It is another feature of the invention that the seal material has a dielectric higher than air and the radial spacing is determined by the dielectric of the seal material.

The seal material may comprise a low loss and low dielectric glass or ceramic material.

It is another feature of the invention that the adaptor and shaft are made of Inconel.

There is disclosed in accordance with another aspect of the invention a high temperature, high pressure process seal probe for use with a process instrument, having a control assembly with a control connection having a 50 ohm impedance, and for extending into a high temperature, high pressure process vessel. The probe includes a sensing element for extending into the process vessel and having a process connection having a 50 ohm impedance. An elongate cylindrical hollow seal adaptor is receivable in an opening of the process vessel and is connected to the control housing assembly. An elongate shaft is coaxial with and extends through the adaptor and is connected at an inner end to the transmission line and at an outer end to the control connection. A hard seal material between a select portion of the shaft and the adaptor is bonded to the shaft and the adaptor. Radial spacing between the shaft and the adaptor is greater at the select portion to provide a 50 ohm feed-through from the control connection to the process connection.

Further features and advantages of the invention will be readily apparent from the specification and from the drawings.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevation view of a process instrument with a probe assembly including a high temperature, high pressure process seal in accordance with the invention;

FIG. 2 is a sectional view of the probe assembly of FIG. 1 connected to an extension housing;

FIG. 3 is a sectional view of the process seal of the probe assembly of FIG. 2;

FIG. 4 is a side elevation view of an adaptor of the process seal of FIG. 3;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4,

FIG. 6 is a side view of a shaft for the process seal of FIG. 3; and

FIG. 7 is a sectional view, similar to that of FIG. 2, for a probe assembly having a flange connection.

## DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a process instrument 10 uses micropower impulse radar (MIR) in conjunction with equivalent time sampling (ETS) and ultra-wide band (UWB) transceivers for measuring level. Particularly, the instrument 10 uses guided wave radar for sensing level. While the embodiment described herein relates to an MIR level sensing apparatus, the teachings of the invention may be used with other types of process instruments for measuring various process parameters.

The process instrument 10 includes a control housing assembly 12, a probe assembly 14, and a connector 16 for connecting the probe assembly 14 to the housing assembly 12. The probe assembly 14 is typically mounted to a process vessel V using a threaded fitting 18. The control housing 12 and connector 16 may be as generally described in Mul-

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DOCUMENT-IDENTIFIER: US 6247362 B1
TITLE: High temperature high pressure probe seal

BSPR:
A time domain reflectometry measurement instrument uses guided wave radar for sensing level. The instrument includes a control housing and a probe. The probe is typically mounted to a process vessel using a threaded fitting or a flange fitting. The probe comprises a high frequency transmission line which, when placed in the vessel, is used to measure level of fluid in the vessel. The probe is controlled by electronics in the control housing for determining level in the vessel.

BSPR:
A time domain reflectometry instrument, as well as certain other process instruments, imparts a pulse signal on the probe and receives a return signal. The relationship between the pulse signal and the return signal is used to determine level. Typically, the control housing includes a 50 ohm control connection for the probe. If the probe has a different impedance, then a mismatch results. The mismatch can cause errors in level measurement. In applications where the probe has a 50 ohm impedance process connection, matching that of the control electrical connection, the design of the process seal can cause an impedance mismatch.

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| 1 | US 6247362 B1 | | USPAT | 20010619 | 7 | High |
| 2 | US 5586054 A | | USPAT | 19961217 | 18 | time- |

US006247362B1

(12) United States Patent
Soroka

(10) Patent No.: US 6,247,362 B1
(45) Date of Patent: Jun. 19, 2001

(54) HIGH TEMPERATURE HIGH PRESSURE PROBE SEAL

(75) Inventor: Valery Soroka, St. Charles, IL (US)

(73) Assignee: Magnetrol International, Downers Grove, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/386,487

(22) Filed: Aug. 27, 1999

(51) Int. Cl.[7] .......... G01F 23/00
(52) U.S. Cl. .......... 73/290 V; 73/566.5
(58) Field of Search .......... 73/290 V, 290 R, 73/866.5

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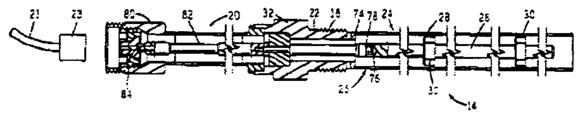
* cited by examiner

*Primary Examiner*—Richard A. Moller
(74) *Attorney, Agent, or Firm*—Wood, Phillips, VanSanten, Clark & Mortimer

(57) ABSTRACT

A high temperature, high pressure process seal is used with a process instrument having a control housing assembly with a 50 ohm control connection, and an elongate probe including a sensing element extending into a high temperature, high pressure process vessel. The probe has a process connection having a 50 ohm impedance. The seal operatively connects the probe to the control housing assembly. The seal includes an elongate cylindrical hollow seal adaptor receivable in an opening of the process vessel. An elongate shaft is coaxial with and extends through the adaptor and is adapted to connect the control connection to the process connection. A hard seal material between a select portion of the shaft and the adaptor is bonded to the shaft and the adaptor. Radial spacing between the shaft and the adaptor is greater at the select portion to provide a 50 ohm feed-through from the control connection to the process connection.

19 Claims, 3 Drawing Sheets

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